

UNIVERSITY OF GHANA

**EFFECT OF CLIMATE CHANGE AND VARIABILITY OF SMALLHOLDER
FARMERS' LIVELIHOODS IN THE FOREST-SAVANNAH TRANSITIONAL
ZONE OF GHANA: A GENDER PERSPECTIVE**



BY

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DECLARATION

I declare that except for references to people's work and views which have been duly acknowledged, this work is the result of my own research, and that this thesis has neither, in part or in whole been presented elsewhere for another degree

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DEDICATION

This thesis is dedicated to all rural smallholder farmers especially women and families in the forest-savannah transitional zones of Ghana on whose sweat a larger population of the Ghanaian population is fed. I also dedicate this thesis to my family for their great sacrifice and support.

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ABSTRACT

Globally, climate change continues to pose a serious threat to ecosystems, food security, water resources, health and economic stability. While these climate change induced effects are well documented, albeit in varying spatial contexts, much of the debate has not gravitated towards evidence of gender differentials in the impact of climate change in recent times, especially among smallholder farmers. Against this backdrop, this study explored gender perspectives on climate change and variability effect on the livelihoods of smallholder farmers' in the forest-savanna transitional zone of Ghana. Specifically, it assessed the perception of men and women smallholder farmers regarding climate change and variability; the differential effects of climate change on their livelihood activities; the adaptive strategies employed by them to improve their production and means of livelihood; and the various institutional arrangements available to support male and female smallholder farmers. The study relied on both quantitative and qualitative data to achieve its objectives. A simple random sampling technique was used in sampling 606 respondents from KAPND and KpMu for the household questionnaire survey whereas focus group discussions and in-depth interviews were conducted among respondents and various institutional heads. The results indicate that majority of respondents were aware of climate change and variability and thus related climate change to changes in rainfall pattern and increase in temperature. Males were more likely to be aware of climate change and variability than females. Respondents reported reduction in crop yields, outbreak of pest and diseases and heat stress as some physical effects. Whereas engaging in off farm activities, migration, changes in agronomic practices and relying on remittances are reported reactive adaptive measures adopted by respondents, use of weedicides and fertilizers, change in planting time and variety of seeds, mixed cropping and tree planting are planned adaptive measures adopted by farmers. However, such adaptive measures are highly contingent on location of farms, financial capabilities and gender. Moreover, the adaptive capacity of farmers in terms of access to credit and social capital were very low. Even though the various government agencies provide some support for farmers, factors such as lack of knowledge of the services, inadequate information about services, unequal access to extension services, traditional/cultural barriers, and women's excessive workload were the major causes of unequal access to institutional support. The study establishes that while there may be some subtle spatial and gender differences in modes of adaptive measures often adopted in the event of climate change and variability impact, individuals' ability to adapt are largely contingent on their knowledge and awareness, access to resources and information. Consequently, the study recommends gender-sensitive climate change policies and interventions that focus on individual farmers, farmer groups, and communities' specific needs.

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LIST OF ABBREVIATIONS

CARI	Competitive African Rice Initiative
EDAIF	Export Development and Agricultural Investment Fund
GHG	Greenhouse Gases
GSS	Ghana Statistical Service
IPCC	Intergovernmental Panel on Climate Change
ISFM	Integrated Soil Fertility Management
NCCAS	National Climate Change Adaptation Strategy
NCCP	National Climate Change Policy
UNDP	United Nations Development Programme
UNEP	United Nation Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change

CHAPTER ONE

INTRODUCTION

1.0 BACKGROUND

Climatic change is widely viewed as one of the biggest global challenges of today (Iqbal & Ghauri, 2016; Ozor et al., 2012). With threats to ecosystems, food security, water resources and economic stability, climate change has impacted unfavourably on key sectors like health, energy, agriculture, infrastructure and tourism through rising temperatures, changes in patterns of precipitation and disease outbreaks (IPCC, 2007; IAASTD, 2009). Climate change related problems are directly linked to the livelihoods of local communities and contributes highly to the present global food production fluctuations (Ozor et al., 2012). The effect of climate change is very severe on farmers who depend solely on rain-fed agriculture.

Agriculture is the major source of earnings and food for more than half of the world's inhabitants (IAASTD, 2011). Despite its contribution to economic development and nutrition, it is currently under growing pressure to adapt to global climate change effects (Friedrich, 2010). To meet the increasing global demand for food, farmers are expected to boost food production to levels much higher than what is produced today (FAO, 2012). It will mean enhancing and equipping smallholder farmers who globally serve as a backbone of agricultural production in most developing countries (Nagayets, 2005).

In Africa, about 36 million smallholder farmers across the continent have an average of two acres of land or less for their farming activities (Nagayets, 2005). Besides the challenge of land resource ownership for these farmers, especially women, projections of higher temperatures and uncertainty in rainfall could possibly cut down their crop harvest (IFPRI, 2009). Thoriakson (2011) mentioned that more than half of rural people in Africa

farm in ecosystems where climatic hazards are expected to affect agricultural production negatively by 10-20% over the next 40 years.

With specific reference to Ghana, the impact of climate change on crop production is manifested in periodic local food insecurity (Stanturf et al., 2011). The changing climate is becoming a widespread challenge that is closely related to structural factors associated with extreme poverty and worsening climatic conditions (Clover, 2003). These harsh conditions, including drought and high temperature are also associated with disasters such as bush fires, floods and pest infestations which hamper physical access to food as they destroy food stocks and crops.

Ghana greatly relies on its climate sensitive sectors like agriculture and forest, where natural resource generation is used to support many rural livelihoods. In recent times, there is evidence of shortened rainy seasons (both major and minor) and increase in temperatures in most regions where agriculture and forest resources are highly important, particularly in the forest-savannah transitional zone. Evidence of worsening climate variability and change in the forest- savannah transitional zone, posing a big challenge of decline in rainfall totals, increase in temperatures, increased variability, and shifts in the rainfall pattern in the recent decades is widely acknowledged (UNFCCC, 2015; SRID, 2001; Owusu & Waylen, 2013; Egyir et al., 2014; Klutse et al., 2014).

It is indicated that climatic shifts and extremes in the zone, for example high temperatures, droughts and flooding are threatening crop production, food availability and access in the area (Tachie-Obeng, 2012; Egyir et al., 2014). According to ECOSOC (2008), these challenges together with the decline in soil fertility levels result in poor yield in traditional crops. This makes it crucial for smallholder farmers to try alternative

livelihood sources and adaptation methods (ECOSOC, 2008). This will promote equitable development.

Importantly, since the impact of climate variability on farmers' livelihood activities has space, time and social dimensions (IPCC, 2007), there is the need for a study on gender dynamics of the effect of climatic changes on the lives of smallholder farmers and their adaptation strategies.

1.1 PROBLEM STATEMENT

In Ghana, agriculture contributes significantly to the socio-economic and livelihood improvement of most rural communities (Egyir et al., 2014; ISSER, 2014; Wrigley-Asante et al., 2017). Despite these benefits, the sector is seriously subjected to the vagaries of climate (Oyinbo et al., 2012). Particularly, in Ghana's Forest-Savannah Transitional Zones, food crop production - which is the major livelihood support for smallholder farmers - is largely rain-fed with little irrigation options (Egyir et al., 2014). With decreases in rainfall since the 1970s, Ghana's agricultural crop production has seen challenges associated with increasing population and its corresponding demand for food and raw materials (Owusu & Waylen, 2012). These challenges tend to affect women more than men as their adaptative capacities vary along the agriculture value chain and family care (Baten & Khan, 2010; Cudjoe et al., 2011; ECOSOC, 2008).

It has been observed that the variability in rainfall and temperatures across the country has seriously affected agriculture (Oguntunde et al., 2006). Studies have argued that changes in climatic trend coupled with land degradation are the leading factors for low crop yields and impoverishment of smallholder farmers, especially those in the rural areas (Laux et al., 2007; Laube et al., 2011; Lacombe et al., 2012; Ayivor et al 2015; Boateng et al., 2016). According to Warren (2005), the forest-savannah transitional zone, referred to

as ‘the bread basket of Ghana’, is one of the areas critically affected by climatic changes. Projections by the Ghana Meteorological Agency (GMet) show that the situation could worsen since rainfall is predicted to decline by 2.2 percent by 2020, 8.8 percent by 2050, and 14.6 percent by 2080 (Minia, 2004; Egyir et al., 2014; UNFCCC, 2015). There is empirical evidence of climatic changes; fluctuation in temperature and rainfall patterns in the forest-savannah transitional zone for the past 30 years from about eight (8) monitoring synoptic weather stations according to the Ghana’s 3rd National Communication Report (UNFCCC, 2015; Ayivor et al., 2015). The continuous changes in the climatic pattern has a lot of implications for food crop production and rural farmers’ livelihoods.

Further, climate change is known to affect countries, income groups, and occupations and gender differently (IPCC, 2014). This recognition resonates with IPCC’s argument that a person’s susceptibility to climatic change is one of many factors not excluding gender roles and rural and urban poor, with women being part of the most vulnerable (MESTI, 2013). These gender roles (for example: family food preparation, and care for the sick at home) are often influenced and at times exacerbated by institutional and legal perspective in determining the plight of women (Birkman et al., 2010). There are therefore gender differences in the effect of climate change on men and women (Goh, 2014).

Studies conducted in the study area have focused on climatic variability and change trends, agricultural adjustment and farming practices, food systems covering production, transportation, processing and storage, and occupational perspectives of adaptation to climate extremes (Gregory, 2010; Codjoe et al., 2011; Tachie-Obeng et al., 2013; Klutse et al., 2013). However, evidence regarding the distinctive effects of the changing climate on male and female food crop cultivators in the forest-savannah transitional zone remains limited. To address this gap, this study focuses on assessing the distinctive effects of climate change and variability on men and women smallholder food crop farmers’

livelihoods as well as their adaptation strategies and available institutional supports for informed policy decisions. In line with this, the main question posed for the study is: ‘What are the gendered differential effects of climate change on the livelihood activities of smallholder food crop farmers in the forest-savannah transitional zone of Ghana?’

1.2 OBJECTIVES OF THE STUDY

The aim of the research is to assess the gendered differential effects of climate change on the livelihood activities of smallholder food crop farmers in the forest-savannah transitional zone of Ghana.

The specific objectives are to:

1. Assess the perception of men and women smallholder farmers regarding climatic changes and variability in the study area.
2. Examine the effects of climate change on the livelihood activities of male and female smallholder farmers.
3. Analyse the adaptation strategies employed by men and women smallholder farmers to improve their production and means of livelihood.
4. Review the institutional arrangements available to support male and female smallholder food crop farmers in adapting to climatic changes.

1.3 JUSTIFICATION FOR THE STUDY

Agriculture plays a very significant role in Ghana’s economy providing over 50% of the nation’s earnings as well as giving support for the citizenry’s livelihoods (Casely Hayford, 2011). The sector further generates about 40% of export earnings and serves as a major source of food and government’s revenue (GSS, 2013). Food crop production

occupies an important segment in Ghana's agriculture and it is also known to have contributed 22% of the country's agricultural Gross Domestic Product (GDP) in 2013 (ISSER, 2014). Food crop production is mostly undertaken by women and men smallholder farmers with women and children playing a major role in the food chain processes (FAO, 2013). Usually, production in this sector supports household food consumption with the main part sold to complement household income. As a result, there is the need to closely investigate smallholder food production in current development changes and variability in climate conditions (temperature and rainfall). Since changes in climatic conditions pose a threat to livelihoods, food security as well as reduce resilience of current adaptive practices, there is the need to take appropriate steps towards understanding and developing suitable adaptation measures on food crop production in Ghana.

The study is therefore intended to contribute to the strengthening of support systems provided by governments (at all levels) and development agencies in climate change resilient programmes for women and men smallholder farmers in especially the forest-savannah transitional zone. Understanding the risks and differential impacts of climate change on men and women smallholders would help research institutions and development practitioners, government and relevant stakeholders to develop gender sensitive climatic change interventions including capacity building to improve farming livelihoods equitably. The findings would assist in equitable regional and sub-regional plans and programmes to ensure food security, considering the fact that the zone cuts across the West African region and contributes massively to food supply in Ghana (Tachie-Obeng, 2012).

1.4 RESEARCH HYPOTHESES

Hypothesis 1

H₀: There is no significant difference in the effects of climate change on the livelihoods of men and women smallholder farmers.

H₁: There is a significant difference in the effects of climate change on the livelihoods of men and women smallholder farmers.

Hypothesis 2

H₀: There is no significant difference in the adaptive strategies employed by women and men smallholder farmers in promoting agricultural livelihood.

H₁: There is a significant difference in the adaptive strategies employed by women and men smallholder farmers in promoting agricultural livelihood.

1.5 THE STRUCTURE OF THE THESIS

The thesis is divided into eight chapters. Chapter one introduces the study with a general background which sets the stage for the research problem. It then presents the research objectives, justification and rationale for the research as well as the hypothesis. Chapter two discusses literature relevant to the subject matter, including the theoretical basis and conceptual framework underpinning the study. Chapter three provides description of the study area, discusses the methodology and techniques used in collecting and analysing the data as well as the ethical issues associated with the research process.

Chapter four presents the findings on the demographic characteristics of respondents and the gendered climate change awareness and perception of smallholder farmers in the study communities. Chapter five analyses and discusses findings on the effects of climatic

changes on farmers. Chapter six addresses the findings on smallholder farmers' adaptation strategies to climatic changes in the study areas. The seventh chapter examines the availability, accessibility and equitability of institutional provision to smallholder farmers. Chapter eight which is the final chapter provides the summary, conclusions and recommendations derived from the major findings of the study.

1.6 SUMMARY

The chapter looked at the general background which set the stage for the research. It then presented the problem statement that led to the research objectives and the rationale and justification for the study. The hypotheses and the structure of the thesis were then clearly defined.

CHAPTER TWO

LITERATURE REVIEW AND THEORETICAL PERSPECTIVES

2.0 INTRODUCTION

This chapter presents a review of the literature on gender and the effect of climatic change on smallholder farmers' livelihoods. The chapter consists of two sections. The first section presents empirical findings from various studies worldwide and highlights how different researchers have discussed factors identified in theories on the effects of climatic changes on women and men smallholder farmers' livelihoods. It draws out clearly the influence of the various concepts and variables on sustainable and equitable agriculture in the face of climate variabilities for farmers.

The second section focuses on the philosophical underpinnings, theoretical perspectives and conceptual frameworks, and discusses some concepts/theories that are important for analysing issues on gender and the impact of climate change on agricultural livelihoods. It discusses the concepts of livelihoods and vulnerability approaches, the institutional arrangements, possible adaptive strategies among others, to equitable agricultural productivity in relation to climatic changes. Based on that the conceptual framework for the study is provided.

2.1 CLIMATE CHANGE AND GENDERED AGRICULTURAL LIVELIHOODS

2.1.1 Climate variability and change

Climate is viewed as average weather represents the state of the climate system over a given time period and is usually described by the means and variation of variables such as temperature, precipitation, humidity, and wind, (IPCC, 2014). According to the World Meteorological Organisation (WMO, 2003), "Climate is defined as the average weather in a place for a period". In sum, climate is the measure of weather patterns over a long

period of time, and inherent to climate are changes, both long-term and short-term. Short-term climate changes represent periodic or intermittent changes that occur, and this is termed "climate variability". The WMO defines climate variation as “variations in the mean state and other statistics of the climate on all temporal and spatial scales, beyond individual weather events.” Climate change on the other hand is defined as the “change in the state of the climate that can be identified by changes in the mean and/or the variability of its properties that persists for an extended period, typically for decades or longer (Intergovernmental Panel on Climate Change (IPCC), 2011). The change may be due to natural internal processes or external forces or to persistent anthropogenic (human induced) changes in the composition of the atmosphere or in land use” (IPCC, 2014).

There exist some doubts in science about limits to knowledge concerning the ways and times climatic change shows itself. The IPCC Working Group 1 recognises climatic change as a change over a period of time, resulting from either anthropogenic activities or natural causes (IPCC, 2014). The United Nations Framework Convention on Climate Change (UNFCCC) on the other hand states that ‘climate change is exclusively caused by changes brought about by human activities’. In spite of differences in definition, climate change has become one of the topical issues in recent times, and there are overwhelming evidence of its existence (Yamga et al., 2011).

The certainty in understanding how the earth’s climate system behaves to some extent is crucial for agricultural livelihoods. It is found that the earth is the only planet in the solar system with temperature favourable enough for human habitation (Philander, 2008; Tachie-Obeng, 2012). Naturally, its control system of greenhouse gas is made stable by traces of certain gases like carbon dioxide (CO₂) in the right measure of 0.35% for the survival of flora and fauna within the atmosphere. With the advent of the industrial revolution around the 16th century, CO₂ in the atmosphere has risen disproportionately

from 280 parts per million to about 412 ppm in 2018 (NOAA-ESRL, 2018), which is believed to be the cause for the global warming of the last fifty years. Evidence has also shown that consumption of energy, in the consumption of fuel, natural gas and coal accounts for 66.3% of the CO₂ in the atmosphere, with Africa contributing 3% of the global fossil fuel carbon emissions, despite being home to 14% of the global population (O'Neil, 2007; Tachie-Obeng, 2012).

Some scientists do not believe in climate change but think global warming is just an occurrence that has taken place before, and will take place again, and there is no evidence of climate change. They argue that the increase in CO₂ and its related increase in surface air temperature form natural variability, not climate change (Philander, 2008). These sceptics believe that the current change is just one of the abrupt climate changes in past records. Records from much earlier periods of the Earth's history and geological studies reveal a number of abrupt climate changes throughout recorded history and scientists have revealed evidence of abrupt climate change periods on earth through a study of climate prior to the period of instrumental measurements (paleoclimatology).

Others indicate that climate change is underway and is already causing environmental disasters and calls for an urgent reaction from everyone. The IPCC agrees that there is evidence of increase in global temperature witnessed within the last half century and states clearly that climate change is unequivocal (Rayner et al., 2006; IPCC, 2007). Moreover, the degree of the uncertainties varies depending on the period, region and the climate factor in question (Tachie-Obeng, 2013; IPCC, 2014).

2.1.2 Smallholder farmers' perceptions on climate change and variability

In Ghana, smallholders are often defined on the basis of size of land holding, wealth, market orientation and how vulnerable they are to risk. Agriculture in Ghana is mostly on a smallholder basis (MOFA, 2006: 2013; Chamberlin, 2007). In the context of this study, smallholder farmers are defined on the basis of holding size of lands. Offering about 60% employment and contributing about 30% to GDP in developing countries, agriculture is the backbone of majority of African countries (World Bank, 2011) and many smallholder farmers in Africa depend solely on it for their livelihoods (Dixon et al., 2004). These smallholder farmers face complicated forms of challenges that make them more vulnerable to climate variability (Boko et al., 2007) which they see as a threat to their farming activities, water supply and food security (Comoe, 1977).

Smallholder farmers work hard in increasing food production and reducing the world's poverty (FAO, 2012) by adopting new appropriate farming practices at the face of the changing climatic conditions (Gbetibouo, 2009; Kalungu et al., 2013). The magnitude of the impact of climate change often rests on the range of coping and adaptation practices adopted by farmers (Gbetibouo, 2009). Importantly, skills, know-how and resources are needed for effective adaptation to changing climate by farmers (Baley et al., 2017). However, before any useful and effective adaptations and implementations can be done, farmers first have to observe that the climate has changed, (Maddison, 2006; Gbetibouo, 2009). It is right then, for one to understand that the right perception and position of the problem leads to effective adaptation because no person regardless of their gender, can adapt effectively if they do not make out the realities about changing climate (Boko et al., 2007; Falaki et al., 2013).

Perception rides over resource allocation because without perceiving the hazard adequately, all other deterrents seem hollow. Perception is therefore seen as a precondition for adaptation (Falaki et al., 2013). Often, farmers ability to adopt and implement new technologies and practices as well as adapt to changes depend on how they understand/perceive and react to possible changes in the climate and environment (Kemausuor et al., 2011). Studies conducted at Ejura Sekyeredumase, Ghana on farmers with at least 10 years of farming experience indicates that, farmers' insufficient knowledge about the changing climate and its effects on crop production, affects sustainable agriculture in rain-fed communities negatively (Kotei et al., 2007; Kemausuor et al., 2011). Although over 80% of the respondents believed that the temperature in the district had increased and rainfall patterns changed, resulting in frequent drought, it was observed that farmers who had the correct perception about previous, current and future trends of climate and the environment were able to adapt more effectively to climatic changes (Kemausuor et al., 2011).

Conversely, farmers who lack awareness are negatively influenced on the adoption of appropriate adaptive methodologies (Kalungu et al., 2013). It was found in another study that farmers often take decisions based on their own environmental situations and there is a clear difference between the perceived and real environments (Mather, 1992). It is therefore important for farmers to have knowledge about the way climatic factors work together with soil and water resources for effective adaptation (Mather, 1992; Kemausuor et al., 2011). Indeed, while a low perception of the risk could lead to an underestimation of a risk, a high perception of a risk could result in exaggerated measures and both extremes have negative consequences on farmers' production (Falaki et al., 2013).

Generally, people's understanding of the factors underlying climatic changes vary, ranging from a more scientific approach to a more religious/traditional one (NAS, 2017). The perceptions of most smallholder farmers are unscientific or traditional mainly because most of them are generally poorly educated, and depend on superstitions in explaining natural events (Kemausuor et al., 2011). Hence, farmers are said to base their perceptions on their personal experiences, know-how and character since individuals regardless of gender, form their own intuitive judgments on issues (Slovic, 1987). For instance, a study on community perception of climate change in Bolivia by Christian Aid revealed farmers perception of causes of climate change as disrespect of God and keeping to old rituals and customs (Chaplin, 2007). The people also perceived hailstorm as punishment from God to young women involved in abortion (Chaplin, 2007). At times, some farmers link their livelihoods challenges not only to climate context but also to economic, political, and social factors (Chaplin, 2007; Mertz et al., 2009). Consequently, for effective mitigation and adaptation strategies, farmers should be aware of the changes in climatic patterns, their causes and effects (Kemausuor et al., 2011).

Understanding how farmers perceive climate change and the differences in perception between males and females could throw more light on their production strategies and how they can be improved (Kalungu et al., 2013). Indeed, perceptions indicate how farmers manage long-term changes related to climate change and variability that can be linked to their adaptive capacity (Kalungu et al., 2013). Studies have emphasized on the perception of farmers on climate change and variability and the relationship between farming practices and food security (Bryan et al., 2013; Kalungu et al., 2013).

In relationship to gender dimensions to rural farmers' perception, Falaki et al. (2013), have stressed that, sex is related to climate change perception and adaptation, and has substantial effect on farmers' livelihoods. Teye et al, (2015) in assessing local farmers'

experiences and perceptions of climate change in the Northern Ghana contend that men tend to perceive climatic changes compared to women. They opine that the “differences here may be related to gender division of labour in the household” (Teye et al, 2015). Although women just like men work on farms, they also engage in trading, pottery and other economic activities compared to men who are likely to depend on farming more. Hence some scholars have noted that, people who depend on weather for all their economic activities are more likely to notice changes in climate (Ribeiro & Chaúque, 2010; Mosha, 2011).

Not only is there gendered differences in perceiving climate change, there is also a strong association between perceived changes and household gender because it has been found that women get involved in agrarian activities more than men under critical adverse weather conditions (Welch et al., 2000; Wrigley-Asante et al., 2017). Women tend to participate in numerous agricultural tasks including land preparation, transporting inputs to the field, planting, weeding, harvesting, transporting, threshing and storage of the production, while men are inclined to migrate whenever there is a severe climate hazard (Kalungu et al., 2013). For instance, studies have shown that Kenyan women farmers in the rain-fed semi-arid and sub-humid regions, provide 84% more family labour than men, while Nigerian women provide 33% more than men during climatic related hazardous periods (Kalungu et al., 2013; Wrigley-Asante et al., 2017).

It is perceived that both male and female farmers use their indigenous knowledge in adapting to reduce possible adverse impacts of climate change and women are known to own special skills in seed preservation for instance, among others that must be acknowledged (Kalungu et al., 2013). Perceptions could show how farmers manage short and long term changes in relation to climate change and their adaptive capacities. Further, understanding farmers’ perceived changes in farming practices in smallholder schemes

will allow researchers, development practitioners, extension workers and farmers to develop appropriate agendas and adopt practices to meet present and forthcoming farming needs in various agro ecological zones (Kalungu et al., 2013).

A better understanding of how farmers' perceive climatic change influences their adaptation measures and possibly have influence on the decisions of crafting successful adaptation policies and programmes (Bryan et al., 2009). Development practitioners have recognised perceptions to greatly influence how inhabitants react to risks since perception deals with the mind (knowledge and understanding); mood (feelings, emotions and attitudes); behaviour (changes in behaviour of the observer), and physical (physical or biological signs on the observer's body) (Zube et al., 1982; Boko et al., 2007). As such, public and individual farmer's awareness and understanding of climate change and variability determines the space for policy makers to operate.

2.2 EFFECTS OF CLIMATE CHANGE AND VARIABILITY ON AGRICULTURE

2.2.1 Physical Effects

Recent reports on changing climate point out that the increase of carbon dioxide and other heat-trapping gases in the atmosphere is contributing to global warming. The impact of the changes include more extreme heat events, rising sea levels; melting snow and ice; drought; excessive storms and floods (Tan et al., 2004). Scientists are projecting that these trends will continue and in some cases accelerate, posing significant risks to human health, our forests, agriculture, freshwater supplies, coastlines, and other natural resources that are vital to quality of life and national development. Small-scale farming in Africa is worst affected by climate change because most of the farmers rely solely on rain-fed agriculture and the least changes creates serious havoc to farmers (Mbilinyi et al., 2013).

Many systems are tied to climate, therefore a change in climate can affect many related aspects of where and how people, plants and animals live, such as food production, water availability and use, and health risks (Stocker, 2014). For example, a change in the timing of rains or temperatures can affect when plants blossom and set fruit, when insects hatch or when streams are at their fullest. This can affect habitually synchronized pollination of crops, food for migrating birds, breeding of fish, water supplies for drinking and irrigation, forest health, and more (Stocker, 2014). For instance, farmers in villages in Tanzania observed extreme events of floods, droughts and high temperatures that negatively affected their crop production (Mbilinyi et al., 2013). The variability in climatic conditions really affected the planting and harvesting time for maize and other food crops (Mbilinyi et al., 2013). Climate change has a big impact on agricultural production system; food production and agricultural development will be severely curtailed unless the risks posed by climate change are addressed (FAO, 2010). Rural communities including women are in front lines in the battle to improve food security and at the same time, they must cope with the changing climate conditions. Understanding the diversity within these communities and of which gender dimension is critical can better help planners and policymakers to support them.

Climate risks do not only affect cash crops and large livestock (men dominated areas), but also affect water and energy resources, health, subsistence farming (crops/livestock) and kitchen gardens where women are typically responsible. Farmers in Korogwe community in Tanzania further observed changes in certain types of crops they preferred and disappearance of certain wild grass and vegetation and even small streams/ rivers (Mbilinyi et al., 2013).

In Ghana, studies have shown that climatic change has negatively affected food crop yields in various ecological zones including the forest-savannah transitional zone (Tachie-

Obeng, 2012; Klutse et al., 2013, Egyir et al., 2014). A study conducted by Acquah & Kyei (2012) on the impact of climate change on mean and variance of maize yield in Ghana indicated a decrease in yield due to increase in temperature and decrease in rainfall. Apart from maize, other food crops in the region and farmers livelihoods have been seriously affected by this climatic variability (Stanturf et al., 2011; Klutse et al., 2014).

In relation to the differentiated effects of climate change on women and men smallholder farmers' livelihoods, it has been found that climate change has greater effect on disadvantaged people, groups and communities. The vulnerability of these categories is based on different factors such as age, gender, geography, ethnicity and income group (Agostino, 2010). It also affirmed that climate change will disproportionately affect less developed countries and people living in poverty in all countries, exacerbating inequalities in well-being and in access to food, clean water and other resources. Also, women and children are principally affected because they seem to form a larger percentage of the poor population (Chant, 2008). They also face gender inequalities, social exclusion like cultural restrictions to rally outside their immediate surroundings; and have less access to information concerning early warning systems in times of disasters (UNDP, 2007; Batan & Khan, 2010).

The United Nations Commission on Sustainable Development in 2006 during the 14th Meeting of Women's Major Group, pointed out that climate change has specific gender characteristics. The Commission observed that women are affected differently by the effects of climate change and by extreme climate events that often translate into disasters because of their social roles worldwide. For instance, reduced access to water puts further pressure on women farmers globally, especially in Africa including Ghana. The

Commission further acknowledged that women, being the main collectors of water, spend several hours every day on this task.

In many regions of sub-Saharan Africa, women are also the main producers of food, they provide over 40% of farm labour and contribute significantly to the overall food crop production chain (FAO, 2016). Further, the adverse effects of climate change and environmental degradation on smallholder farmers' health is critical. Climate related health challenges through waterborne diseases as a result of polluted water supplies or more extreme weather resulting in natural disasters like bush-fires can negatively destroy air and food qualities that have serious implications for women farmers in performing their roles as main caregivers (Agostino, 2010). Often, women farmers take on an increased burden of care as they look after other family members and people in their communities as well as having to deal with their own health and farming activities under the changing climatic conditions (UNDP, 2009). This is aggravated by the fact that in some regions, women smallholder farmers have less access to medical services, either as a result of living in remote rural areas where medical facilities are few and far between, and are often not covered by medical insurance schemes (UNDP, 2009).

Women smallholder farmer's vulnerability to climate change is often heightened because of their dependence on natural resources and their traditional limitation in accessing productive resources including decision-making (Agrawal, 2003; EPA, 2013; Jost et al., 2016; Wrigley-Asante et al., 2017). Gender tends to greatly affect the sharing of work, among other things, in the farming household (Welch et al., 2000; Kalungu et al., 2013; Wrigley-Asante et al., 2017). FAO (2016) thus stresses that with the intensification of climatic changes; there is a pressing need of adopting gender-sensitive approaches in order to achieve food security and poverty reduction. It has also been

observed that if the integration of gender concerns into climate change matters are overlooked then inequalities between men and women smallholder farmers could be aggravated (Skinner, 2011) because extreme climatic variabilities and changes could increase women farmers' workloads, reduce their agricultural output and increase food insecurity (UNDP, 2009).

2.2.2 Socio-Economic Effects

Dependency on rain-fed agriculture by most smallholder farmers means their crop production depends on the weather and so a good season means good yield and vice versa (Acquah & Kyei, 2012; Tachie-Obeng, 2012; Mbilinyi et al., 2013). Since farmers depend on their harvest as their main source of income, a bad output for the year means many facets of the farmer's life and that of their families would be seriously affected negatively (Mbilinyi et al., 2013). For instance, on a study conducted on maize production from selected agro-ecological zones in Ghana, Klutse et al. indicated that maize production only contributes over 20% of incomes earned by smallholder farmers in Ghana (Acquah et al., 2012, Klutse et al., 2013).

Importantly, a range of socio-economic stressors such as human population pressure, land shortage, bad land management practices, market forces and household characteristics were found to be affecting agricultural production of smallholder farmers (Maclean, 2009; Ayivor et al., 2015).

Shift in Family and Gender Roles

One key socio economic effect of the changing climatic conditions is associated with changes in the gender roles (Mbilinyi et al., 2013, Wrigley-Asante et al., 2017). Women tend to spend more hours attending to family and house chores and searching for water

during drought at the expense of other economic activities were seen as part of women's role (Mbilinyi et al., 2013).

In a study conducted in Lushoto and Muheza villages in Tanzania, most men now participate in water fetching with bicycles and other means (Mbilinyi et al., 2013). This is altering the gender division of roles and labour, where traditionally certain roles are designated to specifically one sex. In addition, during flooding seasons when firewood is hard to come by, and also because of reduction of forests, fetching firewood has become difficult hence men in many households assist by using bicycles in fetching them. In the past, firewood and water collection were basically women's roles but because of scarcity men are currently getting involved in such activities (Mbilinyi et al., 2013).

Rural urban migration by young men due to crop failure is seasonal and could be the cause of the spread in venereal diseases including HIV/AIDS (Mbilinyi et al., 2013). Thus, men who leave their families behind could be involved in extra marital relationships and upon return to their families to continue with life as normal without realizing immediately the spread of the disease contracted (Mbilinyi et al., 2013). For this reason, climate change is in a way could be linked to the spread of venereal diseases including HIV (Mbilinyi et al., 2013).

Income Change

Climate change is known to be affecting smallholder farmers' production levels negatively (Cudjoe & Owusu, 2011; Tachie-Obeng, 2012; Klutse et al., 2013; Wrigley-Asante et al., 2017). Knowing that farmers depend mainly on their crop yields for income and livelihoods, any bad occurrences due to bad seasons like shortage of rainfall, drought, floods, bushfires indicates a reduction of their income levels and increase in hunger (O'Neill, 2007; Mbilinyi et al., 2013). When income levels are low, a responsible adult

may not be able to hold his responsibility fully as expected leading to low esteem and respect in the family.

The two factors that determine the quantity of farm output are the size of the farm and whether the season was good, in terms of availability of rains (Mbilinyi et al., 2013). Most farmers have small farms and cannot produce in very large quantities to earn more income.

Further, farmers may not be able to produce more due to the bad season with shortage of rainfall, high temperature and floods. This affects their income, as well as their food security levels negatively. It implies that when their earning capacities are challenged, it goes a long way to affect the settlement of health bills, children's fees and other key social responsibilities (Mbilinyi et al., 2013). Those identified to be affected most within the communities are children and elderly because they can less cope with the adverse climatic effects (Mbilinyi et al., 2013).

When farmers produce a lot they do sell the surplus food produced (Mbilinyi et al., 2013). This happens when the farmers get a good season. Farmers nonetheless can face challenges in marketing even if they are able to produce enough in certain good seasons. Some farmers argued that experiencing a good year with high yield does not automatically translate into good proceeds from the crops produced (Mbilinyi et al., 2013). Other challenges they face include low demand and selling prices, there is no freedom to decide the price and markets are unreliable markets as they are sometimes highly regulated by the government sometimes bans exports hence killing the market for their crops (Mbilinyi et al., 2013).

It has been found that the diversified methods have enhanced farmers yield and incomes and contributed to their socio-cultural needs (Ayivor et al., 2015). Women seem to be

more vulnerable because they have fewer resources to cope with the seeming threats climate change brings along and they have less potential to diversify their income base (Fussel, 2007).

Effects on employment and jobs

Bad season due to climatic changes such as drought and lack of rainfall is associated with reduced economic activities that provide employment opportunities in communities (Mbilinyi et al., 2013). In rural settings, agriculture have big multiplier effects and serves as the main source of employment, so when there are little or no rains, it means there will be no/little harvest for crops leading to low jobs opportunities in the farms (Mbilinyi et al., 2013). When crops fail, it affects wage workers who support during harvesting and transporting produce home or market. The employment for the chain of all middle men who buy farmers produce until it reaches the consumer will have no work when crops fail (Mbilinyi et al., 2013).

The climatic change related decline in farming output, employment and earnings has an added negative consequence in food security since less food is produced. During shortages, the little food available becomes expensive affecting everybody in the community in general (Mbilinyi et al., 2013).

2.2.3 Psychological Effects

Climate change has significant impact on farmer's psychology and welfare, yet most research work about the impacts of climate change have generally focused on physical impacts. For example; increases in heat and drought, extreme storms, rising sea levels etc (Clayton et al., 2014; Nndamani & Watanabe, 2016). Impacts of climate change do not end at structures and systems but continues to impact the well-being and psychology of people (Clayton et al., 2014).

The effect of climate change on human welfare varies extensively amongst individuals and communities (Clayton et al., 2014; Ndamani & Watanabe, 2016). Several factors however exacerbate the vulnerability of individual farmers and communities' to the psychological effects of climate change. These factors include the intensity and rate of recurrence of climate impacts, destabilized physical infrastructure, social stressors, economic inequalities, socioeconomic and demographic variables such as levels of education, large numbers of children and old age (Clayton et al., 2014).

Psychological impacts of *climate change and climate variability* arise through several ways including direct natural disasters like floods, wildfires, and heat waves (Clayton et al., 2014). Other effects may be due to prolonged physical consequences, impacts like rising temperatures and sea levels, and insecure food systems etc. (Clayton et al., 2014).

In conceptualizing human well-being, it is important to identify well-being beyond the absence of injury or disease but also, the opportunity and ability for humans to prosper, adjust and withstand shocks (Clayton et al., 2014). With farmers, well-being is not only supported by a healthy mind in a healthy body, but by a healthy family, community and network of social relations/interactions around the farmer (Clayton et al., 2014). Climate change and its rapid surfacing in the past years pose challenges to farmers and community health, combined with poverty, inequality, and contagious and non-communicable diseases (Costella et al., 2009).

Whilst categorizing human wellbeing impacts of climate change, Clayton et al., (2014), considered impacts on mental, physical and community health as the three important categories. For example, extreme weather conditions like heat waves, bush fires and drought may be associated with behavioural and mental disorders (Nitschke et al., 2011). Key mental health impacts include increment in the incidence of stress, anxiety, and

depression, as well as increases in severe reactions like Post-Traumatic Stress Disorder (PTSD) (Clayton et al., 2014). PTSD is often linked to destruction in quality of life accompanied with high level of distress (Tan et al., 2004).

As there are relationships between natural disasters, mental health and psychological performance (Norris et al., 2002), one may expect likely increases in mental health-related symptoms and conditions as a result of climate change with impact more severe on the poor and rural communities, especially in the developing countries (Mendelsohn et al., 2006). Climate change related floods, bush-fires and droughts that affect smallholder farming negatively is often accompanied by stress-related psychiatric and physical health challenges (Norris et al., 2002). According to Blinderman et al. (2008), such physical ailments can lead to poor quality of life and psychological agony confirming the relationship between physical and psychological health. Usually, natural disasters may be seen as the root cause of physical trauma for most smallholder farmers and could even lead to some deaths. For example, the aftermath of related floods or destructive bush fires is often crowded with disappointments, trauma, heart attack, minor injuries, strokes, and other diseases, especially when victims lack necessary medical supplies (Costella et al., 2009).

Regarding those at risk of psychological health impacts of climate change, it has been observed that some categories of people have higher stress levels than others. This group includes children, older adults and women (Clayton et al., 2014), as children and the elderly have tendencies of depending more on others for care (Simpson et al., 2011). Studies have revealed that women get more worried, making them more vulnerable to emotion and Post-Traumatic Stress Disorder (PTSD) conditions including anxiety disorder, and other adverse psychological outcomes (Corrarino, 2008; Trumbo et al., 2011). Coincidentally, reported cases of increment in domestic violence after disasters

like flood or drought (Fritze et al., 2008) have been recorded over the years among smallholder farmers. Further, the risk of not having access to health facilities in most rural settings have compounded the challenge of victims as most health care facilities are located in the urban areas (Ginexi et al., 2000).

2.3 GENDERED VULNERABILITY AND ADAPTATION TO CLIMATE CHANGE AND VARIABILITY EFFECTS

2.3.1 Gendered vulnerability to climate change and variability effects

Gender is the collective social differences between males and females, as defined by societal traditions (CARE, 2010). Feminist geographers argue that the parameters of women's everyday activities are structured by what society expects them to be or do and therefore males and females are engendered differently and as a result valued differently (Rose, 1993). Gender forms one of the components of vulnerability to climatic change, where changes in the climate affect men and women differently as well as amplifies the existing gender disparity (Dankelman, 2010).

Vulnerability is used in various researches, context and disciplines in relation to secure livelihoods, food security, climate change, natural hazards, and other disciplines (Adger, 2006). In general terms, this can be considered as an internal risk factor of the system that is exposed to a hazard and corresponds to its deep-rooted fragile position to be prone to damage (McLaughlin & Dietz, 2007). Adger (2006) argues that the concept of vulnerability has been a powerful analytical tool for describing states of weakness to harm, powerlessness, and marginality of both physical and social systems, and for directing normative analysis of actions to enhance well-being through lessening of risk.

Vulnerability to climate change is defined as “the degree to which a system is susceptible to or unable to cope with adverse effects of climate change, including climate variability

and extremes” (IPCC, 2014). Climate vulnerability is a function of the character, magnitude, and rate of climate variation to which a system is exposed, its sensitivity, and its adaptive capacity. The degree of vulnerability differs with seasons, individuals, households and communities (Kakota et al., 2011).

Vulnerability assessments generally tend to include additional factors that increase their relevance for decision-makers. According to Ozor et al. (2012), vulnerability assessment is achieved by a more comprehensive representation of the main stressors affecting a system, including non-climatic stressors (environmental, economic, social, demographic, technological, and political dimensions), and considering the socio-economic factors that determine the differential potential of communities to adapt to changing conditions. They noted also that the presence of multi-stressors have a synergistic effect when they interact with climate change and variability impacts which tend to lower the adaptive capacity of smallholder farmers to the prevailing risks (Ozor et al., 2012).

Even without climate change, Africa’s agricultural development has been severely constrained by several multi-stressors that include: poverty, poor governance, underdeveloped markets among others (Ozor et al., 2012). Further, the continent has low adaptive capacity that makes it more vulnerable and exposed because of high rates of poverty, financial and technological challenges (Vogel, 2015). Africa also relies too heavily on rain-fed agriculture interlinked with constraints like land degradation, poverty and climate variability and certainly the rising temperatures will exacerbate existing problems and vulnerabilities (Vogel, 2015).

Gendered vulnerability can be vicious in that, being vulnerable or disadvantaged in one opportunity can lead to exclusion and denial of others (Ohenewa-Beneh, 2012). In the context of the literature, three broad explanatory factors have been identified to account

for the gendered nature of vulnerability to climate change namely: (a) structural inequality, (b) discriminatory ownership and management of resources and, (c) sociocultural barriers. Whitehead and Tsikata (2003) in discussing women's land ownership rights in Sub-Saharan Africa asserts that disparities in access to and ownership of productive resources such as land renders women with fewer assets. Further, studies conducted in Ghana have shown that vulnerability can be worsened by gender roles and relations, and women are at more risk in relation to livelihood activities that includes smallholder farming and other income generating ventures (Awumbila, 2004; Wrigley-Asante, 2008). Further it is argued that, women farmers have poor access and usage of productive resources, lower literacy rates, have heavier domestic workloads that places them at more disadvantaged position than men (Wrigley-Asante, 2008; Ohenewa-Benneh, 2012).

It is recognized that vulnerability of a system depends on its exposure and sensitivity to changes and its ability to manage these changes (IPCC, 2001). Smallholder farmers are affected by and are vulnerable to changes and global warming, but women are known to carry more of the liability (UNDP, 2010). Women farmers' high vulnerability is not limited to their physical and biological settings only but are strongly influenced by the social, institutional and legal perspectives (Birkman et al., 2014). Vulnerability should then be seen as a critical product of marginalisation but not necessarily an inborn feature for female smallholder farmers (UNDP, 2009).

IPCC (2007) recognizes that a person's vulnerability to climate change depends often on gender roles and relations; with rural women in developing countries being one of the most vulnerable groups. Vulnerability being a function of a variety of social, economic, and political factors influencing the distribution of risk across society, it must be

addressed with urgency considering gender scopes (Brown & Wilby, 2012). It is found that, climate change can exacerbate existing inequalities between and among women and men, and intensify gendered experiences of poverty (Demetriades & Esplen, 2008). It further, complicates the life and work of women because the disruption of the climate affects food production and water cycles which in turn increases their workload due to seasonal scarcities of basic needs forcing women and girls to walk long distances to collect potable drinking water and fuelwood for home consumption (Lenton et al., 2008). According to Nelson et al. (2009) and Terry (2009) women's livelihood activities most depend directly on the natural environment and climate. Natural hazards have visible impacts on people while changes in rainfall and temperature affect people indirectly through farming (Kakota, 2011). Yet, the extent of vulnerability varies with seasons, individuals, households and communities (Baro & Deubel, 2006).

Women could be more vulnerable to climate disasters, not because they are physically weak, but because they face different conditionality in the societies guided by superstitious customs (Baten & Khan, 2010; FAO, 2012). Largely, in most developing countries, women often live under cultural limitations, have less access and control over resources, less access to information on climate variability; and have difficulties in participating in training processes (UNDP, 2009).

Women smallholder farmers normally are responsible for reproductive tasks such as food collection and energy supply for the household as well as care-giving tasks, such as caring for the children, sick and elderly (Baten & Khan, 2010). Male and female farmers, farmer groups, communities and even nations have varying degrees of adaptation to climate variability and changes making gendered perspective to climate vulnerability critical (UNDP, 2009).

2.3.2 Gendered adaptation to climate change and variability effects

Adaptation to climate change and variability calls for adjustments towards changing conditions of climates to moderate harmful effects and the exploitation of useful opportunities (IPCC, 2014). Adapting to changing climate conditions is a process that has taken centuries and involving men and women always modifying their farming practices to suit the varying climate conditions according to their needs, knowledge and access to resources (FAO, 2013). It is argued that, these modifications which are often short-termed measures to overcome the immediate challenges should be described as coping strategies rather than adaptation since such measures do not consider the long-term negative impacts (Cooper et al., 2008; FAO, 2013).

Adaptation is often part of a coping strategy and not always planned, although it may be considered long-term impacts (FAO, 2013). It may not be realized in a single intervention but with a range of interventions that address the root causes of vulnerability and responds favourably to climate change impacts (Jones et al., 2010). It is however well noting that human beings generally fear change because of the consequences of that change being unknown (Percival, 2013). This has implications for coping/adaptation of farmers in relation to managing the impact of the changing climate on their activities.

Notwithstanding, understanding men and women's past and present coping strategies and their experiences, can help develop long-term adaptation plans and provide the entry point for other gender-sensitive adaptation (FAO, 2011; 2013). For instance, historically, women farmers were seen as natural resource managers and possessed knowledge regarding environmental resources and practices, which could be used as key elements in climate change processes. As a result, IPCC (2014) emphasized the importance of identifying the differences in vulnerability and strength within groups and communities to

help identify the appropriate adaptive strategies. Applying adaptation schemes could lead to changes in social settings. For instance, division of labour may shift when a woman decides to take a new income generating activity that could change positions in the household chores or may take on more health care task in the family, if climate change causes negative health impacts (FAO, 2013).

The indigenous knowledge of men and women farmers can be an important entry for localized adaptation (FAO, 2013). It implies that the different knowledge of men and women farmers should be gathered, acknowledged and treated equally at the local level. It is important to know that local knowledge of less apparent resources like seeds, small food crops, medicinal plants, forest foods are often held by women (FAO, 2013).

Capacity development for effective adaptation should recognize the different needs and roles of men and women since adaptation efforts by farmer households and communities must produce the capacity to deal with increasingly difficult and more frequent conditions and steady changes in climate (FAO, 2013). Minimizing the vulnerability of men and women farmers for future changes including diversification of agriculture requires building long-term resilience, new or different work input, and control of new income, with gender specific considerations (FAO, 2013).

A growing body of literature on climate change and adaptation has highlighted the gendered vulnerability and adaptive capacity to climate change. For instance it has been reported that women in patriarchal societies tend to be more vulnerable to the effects of climate change and less able to adapt than men because of existing societal gender-based and socially-defined responsibility for reproductive and domestic roles, limited access to natural resources, and role in decision making (Glazebrook, 2011; Coulibaly et al., 2015). Adaptation procedure should be location, gender and context- specific and flexible by

basing the processes on climate monitoring and impact assessments and at the same time engaging both men and women stakeholders to develop institutional capacity (FAO, 2013). As such, adaptation in climate change can be enhanced by altering exposure, reducing sensitivity of the system to climate change impacts and increasing the adaptive capacity of the system while openly acknowledging gender specific results (OECD, 2010). Adaptation for smallholder systems promotes food security, poverty reduction and structural change whilst commercial agricultural systems are concerned with resource efficiency and emissions (FAO, 2010).

For successful adaptation to climate change and increase in food security, agricultural resources must be made equally accessible to both women and men. It is then essential to understand gender vulnerability to climate variability in order to develop appropriate adaptation strategies. This is in line with the suggestion of UNDP (2009) that achieving success in adaptation to climate change requires that gender considerations to decision-making processes, access to and control and distribution of resources /benefits at all levels of vulnerability and the autonomy of men and women must be established.

2.4 POLICIES AND INSTITUTIONAL ARRANGEMENTS FOR GENDERED CLIMATE CHANGE ADAPTATION

2.4.1 Policies for gendered adaptation to climate change

Most developing countries are blessed with rich natural resources but poor management, coupled with natural phenomena such as erratic rainfall patterns and climate change and variability, that is progressively threatening the sustainability of resource use, and hence the livelihoods of poor people (UNEP, 2008; Ngigi, 2009). Studies have revealed that a drastic change in policy approach is required to adequately address these threats for an equitable use and management of natural resources for poverty alleviation, socio-

economic development and sustainable environment (Ngigi, 2009). It is acknowledged that women are the backbone of agriculture in developing countries, including Ghana. Yet, they are faced with challenges that limit their production and as such gender sensitive policies would have to be put in place for equitable development (Kiptot & Franzel, 2011; FAO, 2013). Creating an enabling policy atmosphere for climate change interventions to benefit women at both national and local levels is therefore crucial for fair growth (Kiptot & Franzel, 2011).

The National Climate Change Policy (NCCP) of Ghana provides strategic direction and co-ordination of issues on climate change (MESTI, 2013), with the social development component seeking to address the key concerns of the vulnerable communities for empowerment. Further, the National Climate Change Adaptation Strategy (NCCAS), influenced by international obligations, shows Ghana's commitment to UNFCCC to make sure climate change is adequately featured in the national development planning as well as being responsive to the Hyogo Framework of Action (HFA). It aims at increasing Ghana's resilience to climate change impacts, through awareness creation, mainstreaming gender and rigorous ways of minimising vulnerability in the environment (MESTI, 2013). Ghana's climate change policy is grouped into four thematic and strategic areas of agriculture and food security; disaster preparedness and response; equitable social development; and then energy, industry and infrastructure, all geared towards the communities' strong resistance and improvement (MESTI, 2013).

It is inferred that, the preparation and formulation of the policy did not see climate change as a threat to only the agrarian population that largely depends on rain-fed agriculture for its livelihood but also on other economic sectors like energy and industry (MESTI, 2013). Subsequently, both short and long-term development strategies, with gender indications,

have been established to address the effects of climatic change on agriculture and other key economic sectors through policy and institutional integration (MESTI, 2013; Egyir et al., 2014).

2.4.2 Categorising of institutions for smallholders' adaptation support

Individual adaptation actions are not independent but are constrained or enabled by institutional processes such as regulatory arrangements and societal norms associated with rules in use (Comoe, 1977; Adger et al., 2005). Farmer support services are said to be dwindling in most countries in sub-Saharan Africa (Ngigi, 2009). As such, the capacities of institutions that provide adoption of agronomic support should be assessed and built to be able to provide assistance for farmers and vulnerable social groups to improve their adaptive capacities (Egyir et al., 2014).

Institutions are defined as regulations directing how a system can operate at different levels being local or international (Uphoff, 1986). North (1990) defines them to be 'rules communities come out with to control or shape human interaction'. The interlinked institutions at various levels administer key developmental activity areas that includes agriculture and natural resources, where their roles in supporting climate change adaptation is crucial (Uphoff, 1986; Egyir et al., 2014). The categorization of institutions for smallholder farmers help in understanding institutional structures/power, rights, and entitlements at multiple levels of governance, to further appreciate the adaptive capacities needed by various farming communities (Leach et al., 2010; Berman et al., 2012). Institutions have a strong influence in transforming current coping capacity into longer-term adaptive capacity (Leach et al., 2010). This makes the responsibility of institutions in assisting adaptation to climate change very significant (Egyir et al., 2014).

Agrawal (2010) categorised the institutions that supported adaptation due to climate changes into three: as public, civic and private. According to Egyir et al. (2014), these institutions facilitate and shape adaptation practices in various ways including diversification of livelihood activities and storage strategies for storing perishable farm produce, among others. Further, through external programmes, (for instance in leadership, information, technology, and funds mobilization); they are able to mediate smallholder farmers' livelihood results at the household level. These institutions play important roles in influencing adaptation to climate change in various ways, notably in: (a) linking households to local resources and communal accomplishments; (b) influencing the direction of external support to different societal groupings; and (c) connecting local people to national programmes (Egyir et al., 2014).

Various studies have discussed that communal commodities (like road and rail network, and rule and laws) are best handled through collective action, where decisions are jointly taken by collaborators to settle a common interest (Saddler, 1980). The studies revealed that communities with participatory and inclusive institutional plans often satisfy major communal needs of the people. Importantly, some institutions work jointly or individually in backing households in adapting to climatic changes at various levels (Newell, 2008; MESTI, 2013). A number of studies in the forest-savannah transitional zone in Ghana have reiterated that when multiple stakeholders and institutions come together, they are better able to come up with appropriate interventions that promote effective adaptation and adoption practices, especially among smallholders (Yaro et al., 2010; Adjei-Nsiah & Kermah, 2012).

However, institutions could also serve as a barrier as they may not always promote adoption. Institutional barriers to adaptation depend on how the organisation functions and interacts with others and further influence their ability to adapt. Governments and

agencies that serve the general public play a critical role in improving farmers' capacities to reduce risk or make optimal use of climate variability through disseminating agro-meteorological data and tools, conducting vulnerability assessments, and providing policy advice to strengthen institutional approaches to disaster risk reduction (FAO, 2013).

2.4.2.1 Public Institutions

There exist public institutions whose mandates border strongly on climate and climate change matters (MESTI, 2013). They are for governance and administration, and government oversees their activities (Egyir et al., 2014). They depend on state resources to provide basic services, infrastructure and information to the public including the farming communities. The key public institutions concerned with climate related administration and governance in Ghana are the ministries, departments, and agencies (MDAs) and the Metropolitan, Municipal and District Assemblies (MMDAs) that are to ensure decentralization (MESTI 2013; Egyir et al., 2014).

These institutions work according to their legislative mandates and will as such assist bodies that work with smallholder farmers and households accordingly instead of working directly with them (MESTI, 2013). They back scientifically recognized programmes and practices ranging from agronomy, infrastructure, research and other management practices (Comoe, 1977; MESTI 2013). In Ghana, a national development plan like the Ghana Shared Growth and Development Agenda- GSGDA- (2010-2013) integrated climate change into its plans and the integration is likely to be considered in the current National Strategic Plan for forty years, coordinated by the National Development Planning Commission (NDPC) (MESTI 2013).

Since adaptation to climatic change and variability happens locally, local institutions' role in building the capacities of the most disadvantaged as well as improving their adaptation

is critical (Egyir et al., 2014). Local institutions help to maintain and enhance adaptive capacities to adopt. If adaptation is local, then attention to local institutions is critically important when designing adaptation projects and policies (Agrawal & Perrin, 2008). Even though households and communities have historically adapted to climate variability through different strategies, their capacity to adapt depends profoundly on how institutions regulate and structure their interactions (Agrawal et al., 2008). The District Assemblies with support from the decentralised agencies are to take up local level responsibility in NCCAS programmes (Sova et al., 2014).

Social, physical, fiscal and economic services are often the mandated duty of governmental institutions, backed by law to improve community adaptation practices (Yaro et al., 2010; MESTI, 2013). Available at the local level are government departments that have the mandate to link farmers to adequate information and market sources (Egyir et al., 2014). For example, the Agriculture Extension Division of MOFA and the Forestry Commission often collaborate with informal groups such as traditional authorities and opinion leaders to put into operation environmentally-friendly and forest defence rules. Extension services are crucial in supporting farmers' activities in various ways especially to women. Unfortunately, the interaction between agricultural extension officers and farmers seemed to be lower in most developing countries (Morris & Doss, 1999).

Without further attention to local institutions, their role in different types of adaptation - linking local and external bodies for effective adoption practices- cannot be achieved (Agrawal & Perrin, 2008). An institutional obstacle observed includes inadequate policies, poor knowledge and understanding by community members, and lack of dedication from regional and local governmental levels (Egyir et al., 2014).

2.4.2.2 Civic Institutions

Civic institutions include Faith-based organizations (FBOs), NGOs, community based organizations (CBOs), community information centres/media houses (Ngigi, 2009). They are often voluntary organizations that come together to provide social services in response to the critical needs of the people (Robinson & White, 1997, Egyir et al., 2014). Often platforms are created by media houses for instance to discuss developmental and topical issues that stress on their conditions, challenges and explain their impacts (Egyir et al., 2014). Group members often gain from services like credit, infrastructure, information dissemination among others (Ngigi, 2009).

In addition, a lot of civic institutions seek to promote climate change mainstreaming activities, with development partners like the Japan International Cooperation Agency (JICA), African Development Bank (AfDB), the Agence Francais Development (AFD), the Gesellschaft für Internationale Zusammenarbeit (GIZ) offering financial assistance (MOFA, 2013). Some civil society organizations stimulate communities especially women to participate in decision-making processes by contributing to climatic change and adaptation discussions and strategies (Ngigi, 2009). Others also provide advisory services, input supply, credit, training in agronomy and training to women and rural communities to be resilient to climate hazards in relation to adaptive practices in organic or inorganic farming, good conservation practices among others (Ngigi, 2009).

2.4.2.3 Private Institutions

Private institutions are profit-oriented service providers (Bovaird, 2004). They include corporations, partnerships, and sole proprietorship companies etc. Their activities contribute extensively to physical infrastructure, environmental safety and promotion of corporate social responsibility and sustainable supply systems (EPA, 2007)). These

activities include education and training, support for food production, agriculture intensification, forestry, fisheries, and scientific research, monitoring, early warning structures and sustainable water resources management (Egyir et al., 2014). In Ghana, the private sector is substantially supporting climate change adaptation, with financial institutions like Barclays Bank, Ecobank, Standard Chartered Bank, Stanbic, and others sponsoring “sustainable development projects” and innovative climatic projects. Further to this, companies like Environmental Technology Ltd and others have offered livelihood support through funding, technology transfer and infrastructural programmes at the community levels. However, the effectiveness of such programmes is yet to be assessed (Egyir et al., 2014).

2.4.3 Institutional co-ordination for adaptation

The complex nature of the climatic change and adaptation support in Ghana demands harmonization, partnership, and networking. The EPA has been championing climatic change issues, risk and vulnerability management by building the capacities of local communities and NGOs, but its work is to be wholly recognised by central government (EPA, 2007). It stresses that there is no adequate cross sectoral approach to these critical sectoral environmental issues (EPA, 2007). This is due to insufficient technical and financial capacities at various planning levels (EPA, 2007; Egyir et al., 2014). It can then be inferred that, inadequate inter-sectoral and resources support could have negative implications on smallholder farmers’ adaptive capacities. Yet, public and private partnership (PPP) is seen to be crucial in equipping households to adapt smoothly to climatic challenges (Yaro et al., 2010). PPP’s collaboration should be critically explored throughout co-ordination for effective smallholder farmers’ adaptation.

2.4.4 Gender issues in climate change institutional arrangements

The ‘Earth Summit,’ the United Nations Conference on Environment and Development, Agenda 21 of Rio de Janeiro in 1992, Chapter 24 adopted a gender perspective that called for global action for women towards sustainable and equitable development. Some women and the disadvantaged groups’ participation in environmental programmes were seen to be critical for ecosystem management and control of environmental degradation globally. A proposal for active involvement of women in economic and political decision-making, environmental policies and programmes with strong advocacy of Civil Society Organizations and NGOs was made to aid the successful implementation of the Agenda 21. In support for women’s contribution to the agenda, the United Nations Environment Programme (UNEP) has provided tools for promoting gender dimensions of climate change especially at the local level. (Egyir et al., 2014).

Ghanaian women are said to contribute significantly to Ghana’s food distribution, provide about 37% of the labour force and contribute 20% of total GDP, yet they face discrimination in decision-making and employment, and have unequal access to resources such as land, credit, technology and information (MESTI, 2013; MOFA, 2013; ISSER, 2014). In line with UNEP, it is essential that efforts to address gender concerns in climate change, first address gender inequities and recognise the fact that, the effects of climate change are likely to affect men and women differently at all levels (MESTI, 2013). Gender equality and mainstreaming programmes run at institutional levels as institutional initiatives are found to be essential to the successful initiation, planning, implementation, monitoring and evaluation of climate change policies and adaptation projects (MESTI, 2013; Egyir, 2014; www.gender-climate.org).

The Ministry of Gender, Children and Social Protection (MoGCSP) that spearheads women’s interest in Ghana has promoted gender-sensitive strategies in controlling land

degradation and drought cases in Ghana (MoGCSP, 2014). Activities to reduce gender inequalities through micro-credit support for socio-economic empowerment for instance, empower women to be able to adapt effectively to drastic climatic conditions.

Mensah-Kutin (2010) argues that women organizations are working hard together with their counterparts to bring gender into climatic change consultations at all levels. The GNCCP1 highlights gender equity issues as prerequisite for booming climatic change adjustments and equitable social development responses. It must be acknowledged that women are not just helpless victims of climate change, but also powerful agents of change, where their knowledge, skills and leadership abilities are critical (WWF, 2012). It has been proposed at the national level that gender be mainstreamed into national development processes including legislation, policies, and plans, however strategies by local institutions in integrating gender into their programmes is not clear (Egyir et al., 2014).

2.5 THEORETICAL PERSPECTIVES OF THE STUDY

2.5.1 Structuration: Appropriate knowledge construction for inclusive agricultural livelihoods

The philosophy of Structuration, which underpins Anthony Giddens' work on 'The Constitution of Society', was chosen as the right theory applicable to this study because it seeks to develop timeless laws of human organization, which are dynamic and should be planned for (Baskar 1979). Giddens is of the conviction that patterns of human organisation are changeable by human agency and therefore cannot evidence invariant (normal) properties (Giddens, 1984; Holt-Jensen, 2009). The theory argues that when in a population, enough people change their behaviour, then the norm in question is changed because social norms are structures and are dynamic. The importance of this element of

the theory is that, for example most smallholder farmers may decide to do early planting because of the changes in the climatic patterns, if the practice favours them and as such they continue for a long time, then it becomes an accepted adaptation method. This means the old norm of planting late around a certain known time frame has changed to a new and more suitable time for the farmers. This new planting season then becomes the norm replacing the old one and even this is not expected to be static for farmers and the organizations that work with them.

The study highlights the human agency (as male and female farmers, as well as people in the institutions and all actors) in the face of the changing climate on one hand and social structures (as policies, rules, laws, resources, infrastructure, and agencies that enforce these practices) on the other hand. Sewell Jr., (1992) confirms that social structures are the rules, laws and agencies that enforce these practices. In this case, for instance the Forestry Commission's policy of acquisition of a permit before felling of a tree and some MMDAs' bye-laws enforcing indiscriminate felling of trees helps to guide the mode of operation of communities and farmers for sustainable environment. Such institutions that prescribe innovative practices ensure good conservation of the environment and for that matter promotes higher yields for smallholder farmers.

Structural Marxism believes that agents are directed by structures, but Giddens sees structures to be created and re-created through human agency, with agents in the centre (Holt-Jensen, 2009). Giddens (1984) characterized structure as rules, laws, resources, infrastructure, and market systems that constrain the behaviour of agents. Thus, the schemes/systems like financial institutions and extension agencies can amend and adjust their strategies, programmes and policies to suit always farmers' concerns. Any constraining structures to the development of smallholder farmers could be critically assessed and amended by farmers and their major stakeholders.

In Ghana, most farmers (especially women) are constrained by the collaterals needed to be able to access micro credit assistance from big financial institutions. Similarly, inadequate input support in the form of improved seed species/hybrids, fertilizers and insecticides which farmers have little influence over, also serves as a constrain to production. Another big constrain is the poor road network in the rural settings that renders some roads not motorable for carting off farmers' produce to the market. Hence a lot of foodstuffs get rotten on the farms. This does not make farming attractive to the youth who often migrate to the cities for non-existing jobs that are non-existing. Most smallholder farmers (majority women) are categorized among the low-earned/underprivileged groups (GPRS 1) and the situation has been aggravated by the effects of climate change (MESTI, 2013).

Giddens (1984) stressed that agency is human action and to be human is to be an agent even though not all agents are human. It has been recognised that human beings are not always passive receivers of authority and rules created by structures but the custody of agency allows them to act freely. Human action cannot always be predicted because of the possession of agency. Human beings do not always follow the normative ways of behaviour, as they sometimes break the norms. In this case, farmers could default credit payment due to crop failure for instance or farm closer to river banks though the Ramsar policy bans that.

According to Jenks (1998) the problem associated with structure and agency in social life is clear, even if the resolution of it is not. Any approach, which denies the role of individual actors and their agency is teleological according to Giddens and 'implies a derogation of the lay actor(s), who are regarded as cultural dopes or mere bearers of a mode of production', with no worthwhile understanding of their surroundings or the circumstances of their action (Giddens, 1979). It implies that human beings are not robots

but they can make or unmake sense of their social environment, make choices and modify it in various ways which makes them the agents and creators of the social structure and world. Farmers are therefore quick to take adaptation strategies like ‘early planting’ at the face of the changing climate.

Giddens articulates the mutual dependence of structure and agency ‘that the structural properties of social system are both the medium and the outcome of the practices that constitute those systems’ (Giddens, 1991). Further, Giddens perceives human agency and social structure as not a separate concept but as a two-way approach of considering social action. Structure is more specific, detailed and refers to practices which are organized along certain lines that includes procedural rules and practices (Mashanyare, 2013). In relation to smallholder crop production, the agent as well as people in the institutions and all actors needs to work together using the structures (policies, rules, resources, infrastructure etc.) in an interactive way by undertaking decisions and actions that would determine their livelihood outcomes, whether secure or not. For example, farmer organizations like the Agricultural Extension Units, the Forestry Commission and farmer related NGO cannot work in isolation but would have to work with individual farmers, farmer groups and other groups in extending the appropriate farming practices and support services needed. It also looks at smallholder farmers’ capabilities and abilities to undertake their activities and adapt effectively to even larger scale problems in the face of climate change vulnerabilities.

This balanced position is what Giddens (1986) referred to as the duality of structure, where institutional properties of social systems are created by human action and in turn shapes future actions. Thus, individual farmers can work closely with state institutions and emerge as part of societal growth, but also be skilled agents who direct their own

lives through appropriate actions (agency). It points out that the notion of duality represents a key stage in Giddens' structuration journey (Cloke et al., 1991).

Giddens sees structure simultaneously as both constraining and enabling, whilst at the same time, it is being reproduced and transformed by individuals (Giddens, 1979). As a result, some of the laws, rules and guidelines that are set by MOFA and related agriculture departments at the local level on negative farming practices like indiscriminate bush burning/'slash and burning,' may seem to be constraining but on the other hand promotes environmental protection and high food production ultimately in the harsh climate conditions.

One important critique from feminist sociologists points out the omission of consideration of the elements of gender in structuration theory (Murgatroyd, 1989). It is significant for a study focusing on 'people in smallholding agricultural production', where women play major roles in the farming system and production chain. Giddens' structuration theory can be seen to tell 'only half the story' when it comes to its application to gendered dimensions in agricultural development. In addressing this challenge, feminist geographers and activists are of the view that integrating gender into development thinking and programmes is the best alternative for promoting equitable/inclusive development (Kabeer, 2008).

Structuration gives clearly, the philosophical-ontological and epistemological assumptions which frame the research and also serves as the researcher's frame of reference (Brannen, 2008). The combination of epistemological traditions from both the natural and social sciences can largely explain the emphasis, interpretations and approaches used by researchers. Climate change research on vulnerability for instance can adopt a positivist approach, yet there is considerable work in the constructivist tradition

(McLaughlin & Dietz, 2007) in which the subjective world of diverse human perceptions, values, and cultures can also be explored.

Importantly, knowledge from epistemological and methodological issues in climate change vulnerability and smallholder agriculture has evolved with both structural and agency limitations and support. This makes the linkage of structuration theory and the pragmatic approaches very applicable in conducting an academic study of this kind. It helps to bring out clearly differential impacts and the feelings of male and female smallholder farmers (which is more of subjectivity (interpretivism) inclined) in relation to climate change (inclined more to objectivity and for that matter positivism) impacts on their activities and livelihoods.

This study takes a closer look into women and men's food crop production, examines the impact of climate change on their livelihoods, as well as assesses the institutional support in building their adaptive capacity for impacts of climate change. Such a position fits well with the pragmatic worldview, enforced with the mixed methods approach of quantitative, qualitative and exploratory/explanatory sequential research designs. It confirms Sweetman and Luthans (2010) argument that the transformative paradigm theories in mixed methods support inclusion and challenges oppressive social structures. They further demonstrate the applicability of such a perspective among marginalized groups which is in line with this study's objective of assessing the extent to which gender concerns are considered in the context of smallholder farmers' agricultural livelihoods.

A critique from feminist sociologists (Murgatroyd, 1989) points out that by omitting the consideration of gender from structuration theory, Giddens tells 'only half the story.' This study hopes to contribute to recent thinking that suggest the need for highlighting women's productive and reproductive work particularly the household and community

settings into any developmental plans and programmes for inclusive and equitable development (Murgatroyd, 1989; Rose, 1993; Dankelman, 2010).

2.6. SUSTAINABLE LIVELIHOOD CONCEPTS AND APPROACHES FOR AGRICULTURAL LIVELIHOODS

2.6.1 The concept of sustainable livelihoods

The sustainable livelihoods (SL) approach, which originated from the work of Chambers and Conway (1992) at the Institute for Development Studies (IDS), became an institutionalised tool for rural appraisal, poverty reduction and environmental management (Scoones, 1998; Solesbury, 2003). SL is generally acknowledged as covering “...*the capabilities, assets (including both material and social resources) for a means of living. A livelihood is sustainable when it can cope with and recover from stresses and shocks and maintain or enhance its capabilities and assets both now and in the future, while not undermining the natural resource base*” (DFID, 1999). This definition from Chambers and Conway became the foundation for all the livelihood approaches developed later.

Currently, the SL approach and framework is widely used in development work. The approach is being used to re-assess agricultural improvement strategies for sustainable livelihoods. The approach generally looks at the complex situations of the masses, particularly the lives of the rural and urban disadvantaged, not excluding smallholder farmers (Ellis, 2000). Sustainable rural livelihood is a multidimensional concept that looks at the improvement of access of rural families to food and income-generating activities on a long-term basis including smallholder farmers (Ellis, 2000). It covers secured access to and control of resources, assets and other economic activities to counteract risks, shocks and eventualities. Carswell (2002) argues that the sustainable

livelihoods explanations were not consistent and lacked clarity, and one could simply be adding to a conceptual chaos if care was not taken. The first elaborated definition of the concept of sustainable livelihoods used in most constructions reads:

“a livelihood comprises the capabilities, assets (stores, resources, claims and access) and activities required for a means of living: a livelihood is sustainable which can cope with and recover from stress and shocks, maintain or enhance its capabilities and assets, and provide sustainable livelihood opportunities for the next generation; and which contributes net benefits to other livelihoods at the local and global levels and in the short and long term” (Chambers & Conway, 1991; DFID, 2000; Per Knutson, 2006).

Drawing from Chambers and Conway (1992), Ellis (2000), and Allison and Ellis, (2001) arguments, the IDS team saw the approach to be beyond just what ‘people do to make a living, but the means that provide them with the capability to build a sustainable lives, considering the risk factors in managing their resources, and the institutional and policy setting that either helps or hinders them in their search of a sustainable living’.

The livelihoods approach is typically set out in the form of a framework that brings together the principal components that are thought to conform to the livelihoods definition, as well as demonstrating the interactions between them. Importantly, other definitions apart from making people central, highlights issues of ownership, access and decision-making (Ellis, 2000). One of these definitions of livelihoods states:

People have capacity to generate and maintain their means of living, enhance their well-being and that of future generations. These capacities are contingent upon the availability and accessibility of options which are ecological, economic and political and which are predicated on equity, ownership of resources and on participatory decision making.

Apart from the different emphasis placed by different experts, the livelihoods framework helps to: ascertain what people are doing to deal with risk and uncertainty; identify the connections between factors that constrain or enhance people’s livelihoods on one hand,

and policies and institutions on the other hand; identify measures that can reinforce assets, improve capabilities and reduce vulnerability.

The concept of 'livelihood' seeks to bring together the critical factors that affect the vulnerability or strength of individual or family survival strategies. These comprise mainly, the assets possessed by men and women smallholder farmers, the activities in which they engage in, in order to generate adequate standard of living and to satisfy other goals such as risk reduction, and the factors that facilitate or inhibit different people from gaining access to assets and activities.

The SL concept brings together important factors that influence weakness or strength of individual farmer's survival strategies. They comprise assets controlled by people, the activities they engage in to generate a satisfying standard of living with reduced risks (Allison & Ellis, 2001). The SL theory brings the thinking and practice of poverty reduction strategies, participation, sustainable adaptive practices and interventions into a framework for climate change effective policy analysis and development. The framework is not a model that has a universal solution of all livelihood concerns but it stimulates reflection and scrutiny that can be adapted and elaborated depending on the situation (IFAD, 2011).

SL approach has seven guiding principles which are adaptable and flexible to varied local situations. They are: being people-centred; holistic (by adopt many strategies to secure their livelihoods); dynamic; building on abilities and chances rather than focusing on their challenges and weaknesses; promoting micro-macro links; encouraging broad partnerships; and aim for sustainability for lasting poverty reduction. These principles are reflected in the various SL approaches adapted by various developmental organisations in the ensuing chapters.

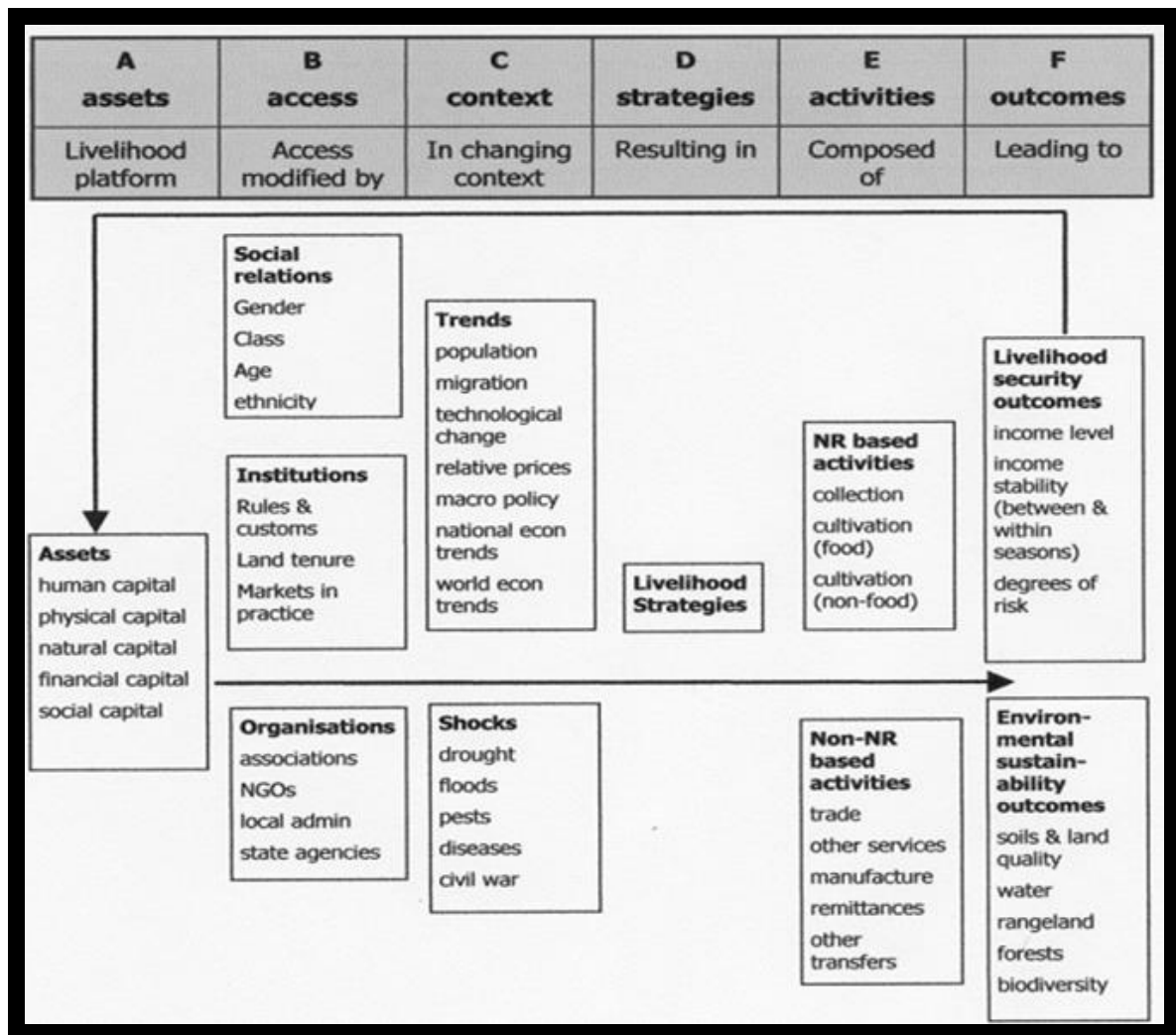
The two livelihood approaches selected for discussing sustainable livelihood strategies for farmers in adapting to climatic changes therefore are the IDS (for micro policy analysis of rural livelihoods) and Livelihood Vulnerability Frameworks (LVF) (testing vulnerability context of farmers).

2.6.2 The IDS' livelihood approach

Building upon Chambers and Conway (1992) and Ellis (2000) work, the initial IDS/SL framework showed how, in different contexts, sustainable livelihoods are achieved through access to a range of livelihood resources or assets (natural, economic, human and social capitals) which are combined in the pursuit of different livelihood strategies (agricultural intensification, livelihood diversification and migration). Central to the framework is the analysis of the range of formal and informal organizational and institutional factors that influence sustainable livelihood outcomes (Ellis, 2000).

The framework looks at different complexity of people's livelihoods. It focuses on the assets of rural people and how patterns of assets control depicts the ability of people to withstand shocks (Chambers & Conway, 1992). DFID for instance, seeks to comprehend the different dimensions of a person's livelihood - the strategies and objectives pursued, and accompanying opportunities and constraints. It is tweaked to analyse the micro policy of the rural livelihoods.

Figure 2.1: Framework for micro policy analysis of rural livelihoods



Source: Ellis, 2000

The framework shows six (6) different classifications, pointing out the access to both assets (natural, physical, human, financial and social capital) as Column A; activities is enabled or hindered by the policy and institutional context (rules and customs, government organizations, NGOs etc.), including social relations (gender, class, age, ethnicity) as column B. It is also affected by external factors -vulnerability context of trends (macro policy, world/national economic trends, migration); and shocks (drought, floods, pests and diseases) outside the control of farmers as column C. Farming families are prone to adverse weather conditions being especially critical like other rural dwellers.

Again, assets permit livelihood strategies to be built, and these are composed of a portfolio of activities, some of which may be natural resource (NR) based (crop farming, non-food cultivation) or non-NR based (trade, manufacturing, remittances) as column E. So farming families often engage in diverse activities in order to achieve livelihood security. Finally, the framework points to outcomes of livelihood strategies, shared between livelihood security effects and environmental sustainability effects as column F.

The livelihoods of smallholder farmers are readily described by the framework with meaning hence its adoption by the study. In this instance, key assets are land, farms, crops, animals, household labour etc. (Bailey et al., 1986). The approach is concerned with understanding the different capabilities of rural families, not excluding how smallholder farmers could cope with crises in climate change that could be droughts, floods, plant pests and diseases.

The livelihoods approach is therefore utilised in different ways to achieve this goal. In development practice, it is being used as a 'process' tool to enable participants in development programmes to identify key constraints and opportunities for development intervention (Ashley & Carney, 1999). This would help to tease out the coping strategies for stress, shocks, changes and uncertainties related to climate variability and provides way-forward for improved food crop production by women and men small-scale farmers for future generations. The goal of the framework is to assist partners in debating the critical factors that affect livelihoods, their significance and how they interact.

The thought is also linked to the concept of vulnerability (high degree of exposure to risk, shocks, stress and susceptibility to climate change effects that could be negative), resilience (ability to bounce back from stress or shocks) and sensitivity (systems response to external disorders) (Allison & Ellis, 2001). The most robust livelihood arrangement is

showing high resilience and low sensitivity, while most vulnerable displays low resilience and high sensitivity. These views are relevant to women and men smallholder farmers' livelihoods.

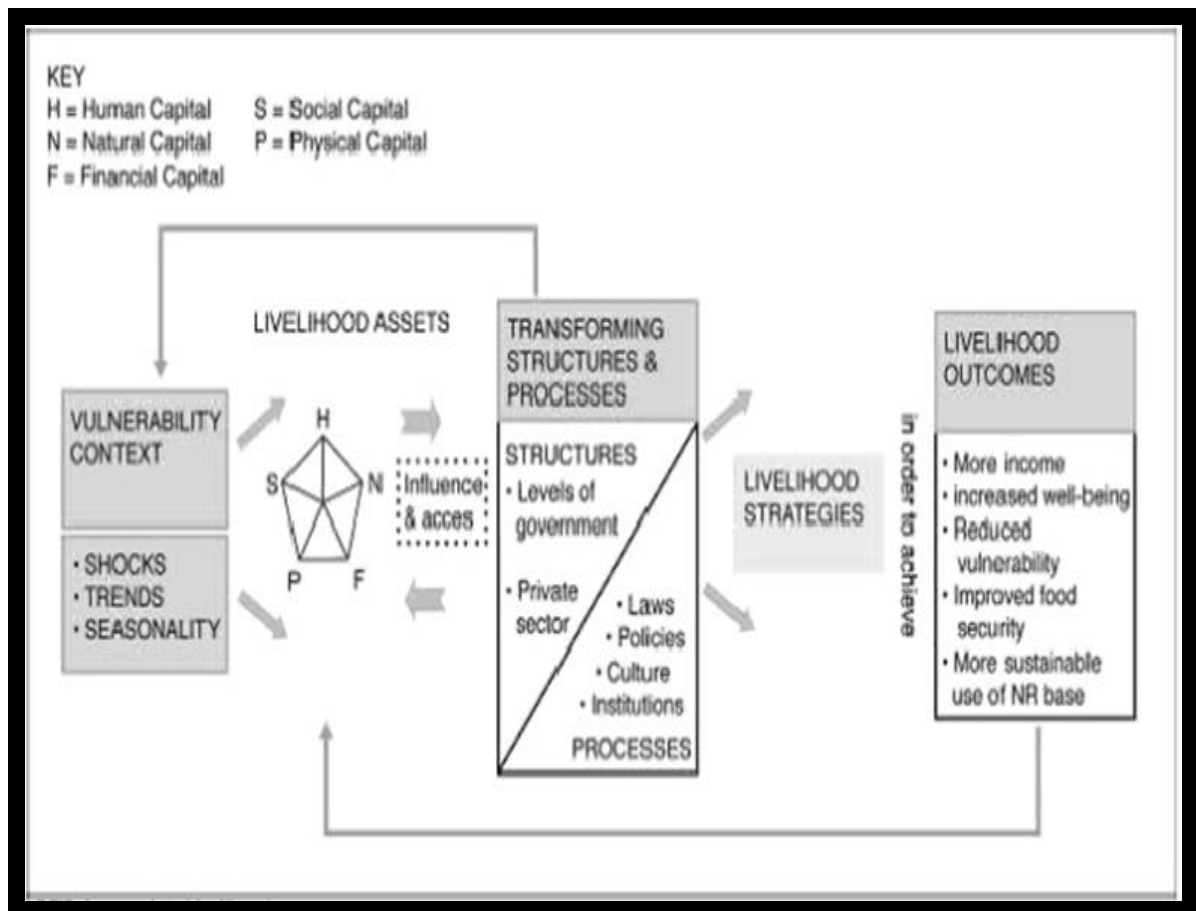
2.6.3 Livelihood vulnerability framework (LVF)

The Livelihood Vulnerability Framework (LVF) is a branch of SLA started by DFID (1999) adopted a very substantial part of the 'vulnerability' context. It integrates analysis of exposures to shock, stress and risks from multiple developmental perspectives. Gender and climate change dimensions are similar to vulnerability, which identifies how different individuals/groups experience and adapt to vulnerability in diverse ways and for various reasons (Ohenewaa-Benneh, 2012).

LVF is an analytical tool that is used to map the elements that restrain the masses from enhancing their living standards (DFID, 1999). It sees vulnerability to own predictive quality that conceptualizes what may happen to people under particular risk and hazard conditions. The framework (refer Figure 2.2) discusses the factors that limit or enhance livelihood opportunities and with that, could predict potential factors that expose the people, in this case smallholder farmers – to climate change vulnerability (Ohenewaa-Benneh, 2012).

The SL framework (Figure 2.2) have five components starting with 'vulnerability' setting where people live their lives with the 'livelihood assets or capital' in their possession, 'transforming structures and processes' such as social norms, policies and institutions as influencing factors that can impact on the 'livelihood strategies'; and 'livelihood outcomes' after the effective utilization of all available resources (DFID, 1999; Ashley & Carney, 1999).

Figure 2.2: Livelihood Vulnerability Framework (LVF)



Source: (Carney et al., 1999; DFID, 2001; Ohenewaa-Benneh, 2012 modified)

2.7 CRITIQUING LIVELIHOOD APPROACH

The livelihood approach has been criticised for having no analytical clarity. It is found to be an important actor/people-oriented initiative but seen to be focusing very much on only how people organized their lives, rather than concentrating on their impoverishment as most survival studies did in the 1980s (De Haan, 2002).

It is further criticized for invisibility of people in the framework and for that matter being without gender considerations. Rhetorically, the approach is supposed to be people-centred but strangely, that is invisible in the framework. Apart from institutions and capital, the human beings being male or female farmers are not visible in the framework.

Also, the absence of leisure from the framework is a critical concern for effective use of resources for higher productivity by farmers (Brinson et al., 2011). Relaxation is critical in human existence especially for women who are burdened with their traditional triple roles in the rural areas (Morse & McNamara, 2013).

Another limitation of the livelihood approach was the neglect of power relations and social structure (market, class, gender, and ethnicity) due to the supposed non-ideological perspective (Moser, 1989). Understanding the operations of power in livelihood structures promotes growth in development and livelihood enrichment (De Haan, 2012).

The approach was over blown and became more popular beyond its proportion. It is freely accessible on the internet, though the approach drew on older approach that was quickly absorbed in academic debates on development issues (De Haan, 2012). It has produced countless varieties with difficulty in presenting a generalized trend. It has also been claimed that there is limited application of LFV framework in appreciating the relationship between gender, climate change, poverty, agriculture among others (Ohenewaa-Benneh, 2012).

2.8 CONCEPTUAL FRAMEWORK FOR THE STUDY

The conceptual framework (see Figure 2.3) that integrates the different frameworks and theoretical underpinnings and approaches discussed above is considered appropriate for the study. The focus of the research is to ascertain whether there is a differentiated impact of climate variability on agricultural livelihood of women and men farmers in relation to their perceptions, effects on agricultural activities, adaptive strategies, and institutional support. In strengthening the analysis, the IDS' Livelihood framework of micro policy analysis of rural livelihoods and the Livelihood Vulnerability Framework (LVF), being a sub-unit of SLA, is used to assist as a strong analytical tool in measuring the state of

weaknesses to harm, powerlessness and marginalization of the vulnerable groups. The IDS and LVF support will help in coming out with actions to improve the risk factors in farmers' lives (Adger, 2006).

The study therefore draws on gender, vulnerability and the sustainable livelihoods concepts (Moser, 1989; Adger, 2006) linking them to climate change (IPCC, 2014). This forms the theoretical basis for improving the livelihoods and resilience of smallholder farmers' activities to impacts of climate change, not overlooking the role of other influencing factors like socio-cultural and institutional effects. It draws on Moser's concept that both men and women are change agents rather than one of them being a passive recipient of development assistance (Moser, 1989). Linking climate change, gender and smallholder farming to the concept of 'livelihood' seeks to bring together the critical factors that affect the vulnerability or strength of individual farmers or family survival strategies. According to Ashley and Carney (1999), in terms of the livelihood framework, women households usually tend to be more vulnerable than men, have access to fewer assets, face different set of constraints, adopt different strategies from men, and pursue different outcomes. It is argued that their strategies often focus on meeting the basic needs of their children for whom they often bear a disproportionate share of the responsibility within the household.

Such a focus helps to assess the degree to which male and female smallholder farmers can be prone to adverse effects of extremes climate variability and change. It allows for the degree and proportions of climate variation in relation to farmers' exposure, sensitivity and adaptive abilities including the stressors like socio-economics/environmental factors that define the anticipated livelihoods of the smallholder farming communities to be interrogated.

The assumption with the framework (Figure 2.3) is that climatic risks and hazards impact on individual farmers (male or female), households and groups of farmers that are at different levels of preparedness and resilience and have varied capacities to recover (Kakota et al., 2011). An appropriate and equitable adaptation strategy that can be developed for farmers is to grasp the fundamentals of gender differentiation in terms of vulnerability to climate variability and its impacts.

It is then essential for development practitioners to note that the magnitude of vulnerability varies with space, seasons, individuals (males, females, elderly, the sick etc.) and households and communities characteristics (Kakota et al., 2011). Further, exposure to risks depends on several factors that determine whether farmers' livelihoods are secured or not. The framework stresses that hazards are supposed to be experienced by all farmers in a household or community being a male or female, but exposure to hazards varies among individuals depending on the socially assigned roles and responsibilities which leads to different exposure to climate hazards and access to resources.

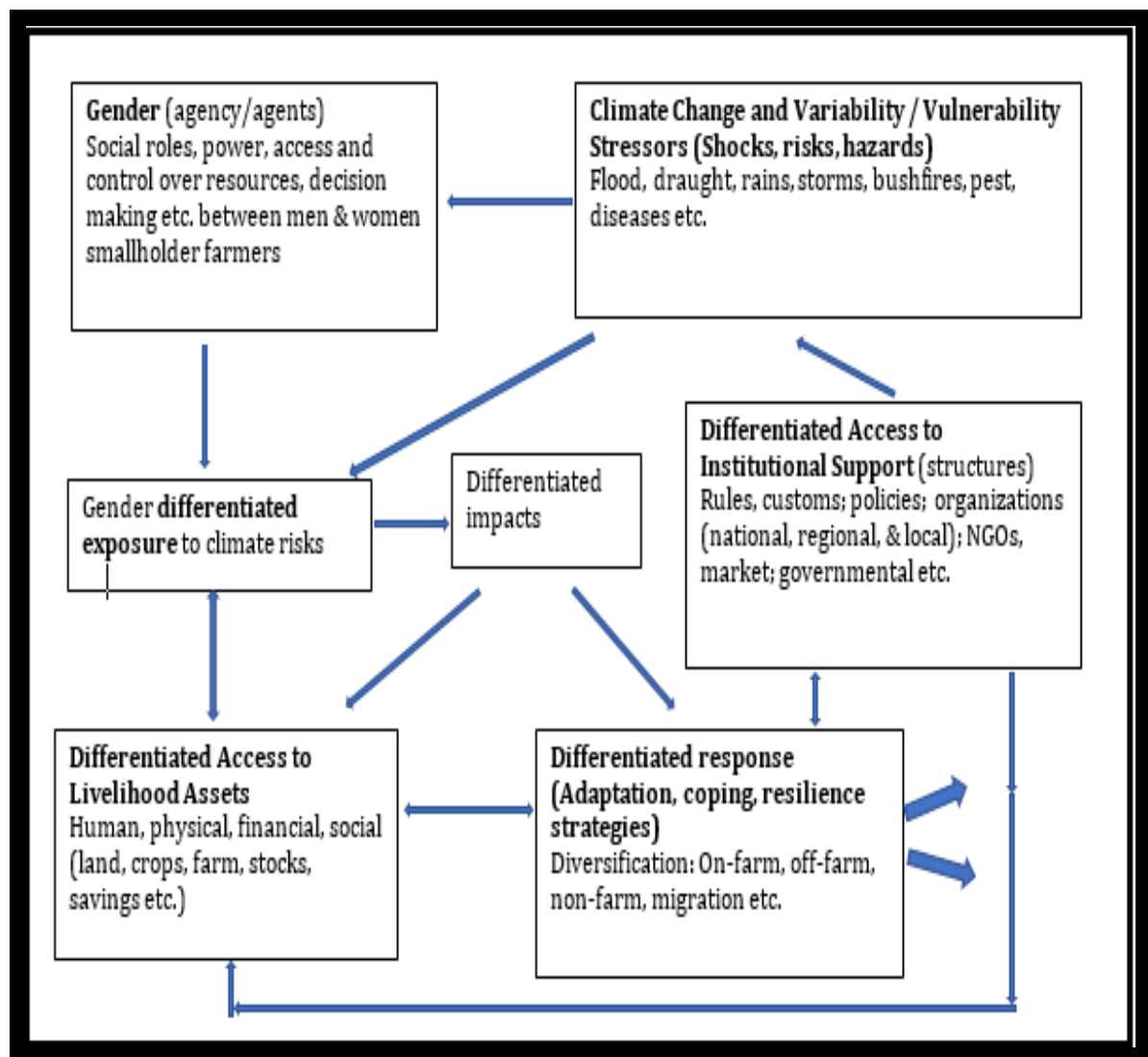
Similarly, impacts from the risks are experienced by all farmers exposed to the risks and vary as well among individual farmers and households (Kakota et al., 2011). Usually farmers susceptible to vulnerability are those who are highly exposed and are sensitive to threats and having their adaptive capacities restrained by natural, physical, social and economic factors (Watson et al., 1996).

As discussed in Figure 2.3, access to assets by smallholder farmers is enabled or hindered by the policy and institutional context of livelihoods. It has been found that assets permit livelihood/adaptive strategies to be built, and these are composed of different types of activities, some of which may be natural resource based and others may not. The adaptive and coping strategies of male and female farmers in response to the risks depends on

many factors such as access to productive resources, cultural issues as well as institutional support (Kakota et al., 2011). The institutional processes mediate the ability of farmers to carry out their activities and strategies to achieve set outcomes or otherwise.

Finally, the framework points to the fact that ‘gender’ - societal norms and roles, power relations, responsibilities and expectations for males and females- has a strong influence in determining who has access to and control over productive resources including information and decision-making processes of an individual small-scale farmer as well as influence the differentiated impact on the adaptive/coping strategies of farmers. Importantly, the extent to which a farmer can access/control these resources is determined by gender relations and roles of being a male or female, bearing in mind that farming activities are often strongly gender-differentiated in relation to all the influencing factors within the communities. The study’s conceptual framework therefore seeks to provide evidence of local dynamics and essential vulnerability factors that require attention for gender-sensitive and effective adaptation, livelihoods policies and interventions for smallholder farmers.

Figure 2.3: Conceptual Framework for Understanding Gender Vulnerability and Climate Change Effects on Small-holder Farmers



Source: Adapted from Scoones, 1998; DFID, 2000; Ellis, 2000; Kakota et al., 2011.

2.9 SUMMARY

The literature review discussed empirical evidence and conceptual perspectives on gender, and climate change and the impact on smallholder farmers in general with a specific focus on women. The discussion emphasized the current debates on the state of knowledge of climate change/variability, the perception of farmers of climate change,

vulnerability and gender issues in climate change and agricultural livelihoods. The adaptation and coping strategies, policies and institutional arrangements for sustainable livelihoods and the differentiated impact of climate change on men and women smallholders were also critically reviewed.

In terms of theoretical perspectives, the philosophical bedrock being structuration, the sustainable livelihoods (SL) and the Livelihood Vulnerability (LVF) Frameworks and their linkages with vulnerability and climate change were interrogated (Sen, 1990).

CHAPTER THREE

STUDY AREA AND METHODOLOGY

3.0 INTRODUCTION

This chapter provides a description into the background characteristics of the study areas. These include the vegetation, drainage, climatic characteristics, demographic characteristics, economic characteristics and social infrastructure of the study areas. In this section, the methodology used in terms of study site selection and targeted population; research techniques regarding data collection and analysis are discussed. It also discusses the ethical considerations of the study.

3.1 STUDY AREA

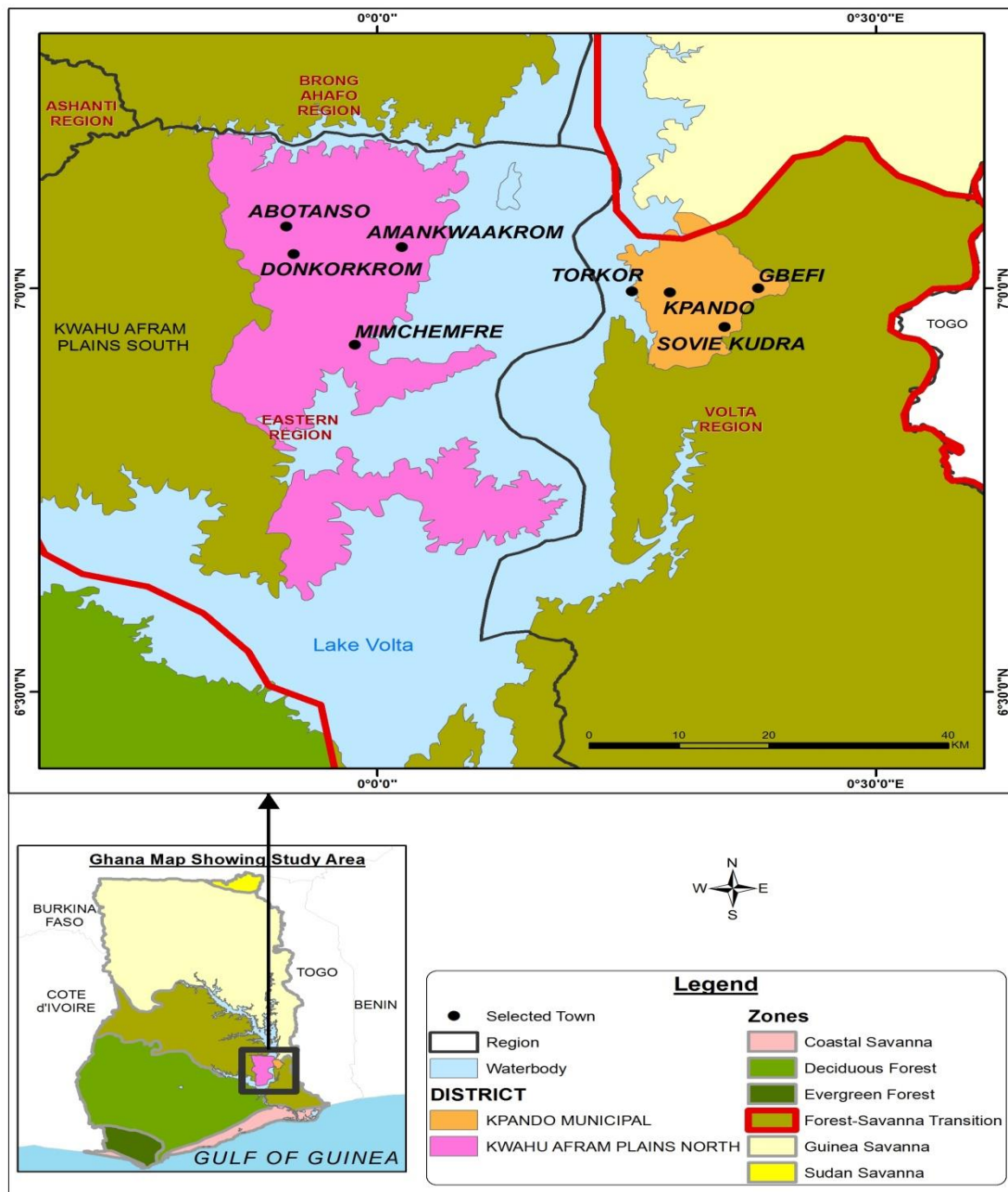
Ghana has six major agro-ecological zones namely Sudan savanna, Guinea savanna, Coastal savanna, Forest-savanna transitional, Semi-deciduous forest and High rain forest zones (Tachie-Obeng, 2012; Egyir et al, 2014). The forest-savanna transition zone, the agro-ecological zone where the study area falls, is a growing zone along forest fringes where grassland is gradually replacing the forest vegetation (Oppong-Anane, 2001, Klutse, et al., 2014; Egyir et al, 2014).

The zone benefits from two maximum rainfalls periods giving rise to a major and minor crop growing season. The major rainy season occurs from March to June, with the minor occurring in September or October (Oppong-Anane, 2001; Tachie-Obeng, 2012; Owusu and Waylen, 2013; Klutse, et al., 2014). In a good year however, the total volume of rainfall in these two seasons may be approximately the same. Mean annual rainfall of 1200mm is usually recorded in the area. The rainfall trend and amount often decreases from south to north of the zone, in line with rainfall distribution patterns in the country (Klutse et al., 2014).

According to Warren (2005), the area is more susceptible to climate change influences and hence requiring attention in the face of current climate change and variability. Furthermore, the area, known for its high agricultural value in Ghana as it significantly contributes to food production (Sagoe, 2006; MOFA, 2013), is getting rapidly degraded, making it much susceptible to climate impacts. The degradation has been attributed to indiscriminate cutting of trees, slash and burn method of land preparation, and burning by farmers and herdsmen (Tachie-Obeng, 2012).

The Kwahu Afram Plains North district and Kpando Municipality in the Eastern and Volta Regions respectively were chosen for the study (Figure 3.1). These areas are fast becoming degraded and susceptible to climate impacts (Cudjoe & Owusu, 2011; USAID, 2011) due to incidence of high rate of slash and burn method of land preparation, and indiscriminate felling of trees combined with burnings of the savanna by herdsmen. As the savanna and forest-savanna transitional zones cover a large part of the tropics, findings from this study would not only be useful for policy decisions in the quest to address climate change and food security in Ghana, but also in Africa and other countries with similar ecological zones.

Figure 3.1: Map of the study area showing the ecological zones in Ghana, the study districts and communities.



Source: Geographic Information Systems Lab, University of Ghana. (Adapted from GSS, 2005; Aning et al. 2008; Stanturf et al, 2011 and Hashmiu, 2012).

3.1.1 Kwahu Afram Plains North District (KAPND)

3.1.1.1 Location

Kwahu Afram Plains North district is located in the Northern part of the Eastern Region with a total of 15 districts and 6 Municipalities (Figure 3.1). Being the largest district in the region, the district covers a landmass of 5,040 sq. km, sharing boundaries with Kwahu South district on the south, Sekyere-East and Asante-Akim districts to its west, Sene and Atebubu to the north and the Volta River to its east.

3.1.1.2 Vegetation and Drainage

The district is generally undulated with landscapes of 60 – 120m above sea level. It is drained by the Afram River in the west, the Volta River in the east and the Obosom River in the north, with these water bodies used for both domestic and agricultural purposes (Kwahu North District Assembly, 2008). In terms of vegetation type, the district comprises of savanna woodland with widely spaced short deciduous fire resistant trees. The area contains few forest reserves covering about 120.8sq km (15%) of the entire surface area (GSS, 2014a).

The major soil group in the district is mainly red, well-drained, deep gravel-free silty loams and silty-clay loams (GSS, 2014a). The soils are suitable for the cultivation of both food crops (cassava, plantain, yam, cocoyam, maize) and cash crops (cashew, oil palm, citrus,) which are grown in the district. The area is susceptible to wind erosion when laid bare of vegetation.

3.1.1.3 Climatic Characteristics

In terms of rainfall, the district is associated with two main seasons with the first starting from May to June and the second from September to October. The mean annual rainfall ranges from 1,150mm to 1,650mm. The dry seasons are distinct, starting between

November and late February. Mean temperatures are usually high ranging from 36.6⁰C to 36.8⁰C between February and March respectively, while December and January have low temperatures between 19.09⁰C and 20.1⁰C. Relative humidity is often high throughout the year with values ranging from 68.2% to 71.6% in the dry season and 81.6% to 71.6% in the wet season (Cudjoe, 2010).

The results suggest that the amount of rainfall received over the years has reduced while temperature has increased though at a decreasing rate. Empirical studies confirm that there are changes in the climatic conditions in the zone, reflecting decline in mean rainfall patterns and increase in temperature levels for the past 30 years (SRID, 2001; Owusu and Waylen, 2013; Egyir et al, 2014; Klutse et al, 2014; UNFCCC, 2015). The changes have serious implications on farming productivity (Cudjoe & Owusu, 2011; Tachie-Obeng, 2012).

3.1.1.4 Demographic Characteristics

The population of the district is 102,423, representing 3.8% of the region's total population. It comprises 52.9% males and 47.1% females, and with 52.4% and 3% youthful and elderly populations respectively (GSS, 2014a). Regarding rural and urban population distributions, about 86.1% of the district's population lives in the rural areas whereas 13.9% live in urban areas (GSS, 2010).

In terms of literacy and education, the population aged 11 years and above comprises 59.5% literates and 19.2% non-literates. Gender wise, there is higher male (33.33%) literacy than females (26.1%). Approximately 60% of the population has acquired basic education with some 3.7% having attained tertiary level education.

The main ethnic groups in the district include Ewes (majority), Akans, and Krachis and mixed groups from the northern part of Ghana. The dominant religious group in the

district is Christians (77.1%) with remaining as Moslems and few traditionalists (GSS, 2014a).

3.1.1.5 Economic Characteristics

The main occupation in the district is farming, which engages about 65% of the citizens in the district. This is followed by fishing and petty trade and craft which form 7%. Approximately 88.5% of the population who engage in farming produce crop whereas 49.9% rear livestock (GSS, 2014a). A proportion of 88.5% and 88.7 % of households engaged in crop farming are respectively in rural and urban localities in the district.

The manufacturing sector is predominantly agro-processing units – (cassava into gari and oil palm processing). This reveals the economy of the area to be mainly agrarian. Distribution of occupation among the sexes shows more male workers (82.1%) engaged in skilled agricultural, forestry and fishery occupations than female (57.7%). The private informal sector is the largest employer in the district, employing 94.3% of the population followed by the public sector with 4.0 percent, with majority as men (Cudjoe, 2010). Being surrounded by the Volta Lake, the Afram and Obosom River offer lot of tourism potentials especially Dwarf Island (GSS, 2014a).

3.1.1.6 Social Infrastructure

The district has fair distribution of accessible roads, majority of which link the Volta Lake and Afram River. Major utilities available in the district include electricity, water and telecommunication which have improved lives and economic activities in the communities (GSS, 2014a). The district derives drinking water from three main sources – from river/stream, public tap and dugout – which together, are used by 76.5 percent of households. A little below 40% of households rely on river/stream sources of water while 14.3 % of households in the urban areas use pipe-borne water as compared to 1.8 % of

households in the rural areas. Most households (0.2%) use protected wells for domestic purposes (GSS, 2014a).

3.1.2 Kpando Municipality (KpMu)

3.1.2.1 Location

Kpando Municipality is located in the Volta Region of Ghana. It shares boundaries with Biakoye District in its north, Afajato South to the east and North Dayi District to the south. The area is made up of approximately 380.3 square kilometers landmass representing 4.5% of the entire land area of the Volta Region. Kpando, the Municipal capital, is about 70km from Ho, the regional capital making the municipality a strategic area with potential for fast economic growth and development (GSS, 2014b).

3.1.2.2 Vegetation and Drainage

The municipality lies within the semi-deciduous forest vegetation zone of Ghana with approximately 30% of its landmass submerged in the Volta Lake which stretches over 20km in length. The area falls within the tropical equatorial zone of the country with the lake demarcating the western boundary of the area and providing potentials for irrigation agriculture, aqua-culture and fishing. River Dayi that lies in the eastern portions of the study area provides prime farming land for the cultivation of a variety of food crop and vegetables (GSS, 2014b).

The municipal area is characterized by a mix of guinea savannah woodland and semi-deciduous forests. The savannah woodlands is scattered with grass and trees like acacia, bamboo and baobabs, found along the River Dayi Basin. The semi-deciduous forests on the other hand are found on the slopes of Akwapim –Togo –Attakora ranges with many tree species e.g. *Antiaris toxicaria* (Odum) and Oil palm found in high forest zone (GSS, 2014b). The soil is basically ‘savannah ochrosols’ (reddish, lightly acid; more nutrient)

and ‘oxysol’ (heavily drained; yellowish; less nutrient and ground water laterites) characterized by sandy loam type of soil (Kpando Municipal Assembly, 2014).

3.1.2.3 Climatic Characteristics

Kpando Municipality is generally influenced by the South West Monsoons wind from the South Atlantic Ocean and the dry harmattan winds from the Sahara. The district is characterized by double-maximum rainfall with average annual rainfall ranging from 900mm to 1,300mm (GSS, 2014b). This rainfall pattern experienced in the area makes it suitable for crop production throughout the year, ensuring food security as well as regular income of farmers.

Major rainy season occurs from mid-April to early July and minor season from September to November (GSS, 2014b). That notwithstanding, the Municipality has seen no significant improvement in rainfall situation. Mean annual temperature is about 27°C, whereas the daily means ranges from 22°C to 33°C (GSS, 2014).

The fluctuating climatic conditions in the area confirms Ghana’s 3rd National Communication Report that has projected rainfall and temperature in the forest-savannah transitional zone from 1980 – 2010 (30 years) from 22 synoptic weather stations across the country. This includes the Ghana Meteorological Agency (GMA-GMET) report showing variable rate of changes and indicating that the mean temperature is likely to increase in the near future by 3.8% (1.02°C) and 112% with projected decrease of 2.9% in the near future (2040) in the zone (UNFCCC, 2015). Furthermore, various empirical studies have confirmed the climatic variations and changes causing decline in rainfall and increase in temperature levels (SRID, 2001; Owusu and Waylen, 2013; Egyir et al, 2014; Klutse et al, 2014).

In a study conducted in Ejura-Sekyedumase District of Ghana within the zone, the rainfall and temperature patterns kept fluctuating from 1993 – 2004 (Kemausuor et al, 2011). The rainfall pattern kept reducing but could be erratic with extremes that could lead to flooding and drought. The mean average temperature increased to 33°C and variations were large enough to interrupt negatively crop growth and yield. It is therefore evident from official publications and sources that climatic changes are actually taking place in the zone.

3.1.2.4 Demographic Characteristics

The Municipality has a population of 53,736 with males constituting 48.21% whilst females form the remaining 51.79% (GSS, 2014b). The growth rate between 1970 and 2000 was 1.7% suggesting a population increase by 15% compared to the regional figure of 35% during the same period (GSS, 2014b).

Dependency population (0-14) years and 60 years and more form approximately 44.77% of the entire population in the assembly implying only 55.23% active population in terms of work. The situation imposes lot of burden and negative effects on the quality of life of the youth and entire assembly. The area is predominantly urban (55.01%) with rural coverage of 44.99% (GSS, 2014b).

3.1.2.5 Economic Characteristics

The majority of the people in the settlement areas within the municipality are mainly peasant farmers with low level of socio-economic infrastructure and commercial activities. However, the socio-economic conditions of majority of the people are still characterized by poverty resulting from income inequality, low living standards and generally poor quality of life despite considerable poverty reduction strategies and related interventions implemented over the past years (GSS, 2014b). Overall incidence of poverty

in the Municipality is about 44%, with rural and urban incidences of 51% and 21% respectively (GSS, 2014b).

Workers in agriculture, animal husbandry, fishing and hunting constitute the largest occupational groups in the Municipality and accounting for 62% of the active population (GSS, 2014b). The wholesale, retail trade and related workers also constitute a significant proportion of 11.4%, of the work force. Out of this figure the females form 15.1% while males form 7.4%. Gender-wise, the area records higher percentage of males (40.3%) skilled in agriculture, forestry and fishery works than their female (24.6%) counterparts (GSS, 2014b).

Crop production in the area is characterized by small farms land holdings with average farm size of less than a hectare. Food crops such as maize, rice; plantain cassava, yam, and other vegetable especially garden eggs are mostly grown on subsistence level. Annual production varies with rainfall pattern, level of soil condition and production technology. The increasing cost of farm inputs, unstable prices and the low soil fertility accounts for decreasing profit margin of agricultural sector workers in the municipality (GSS, 2014b).

3.1.2.6 Social Infrastructure

Kpando Municipality is accessed mainly by a mixture of road network of highways, feeder roads and water transport via the Volta Lake. The Volta Lake with a shoreline of about 80km long forms the western boundary of the Kpando Municipality making it accessible by river crafts and engine boats. This provides opportunity for interaction between the two entry points of Kpando Torkor and settlements in the Kwahu Afram Plains North (GSS, 2014b).

About 95% of the communities in the Municipality are connected to the National Grid electricity (GSS, 2014b). The Municipality has a Post Office located at Kpando, two commercial banks (Ghana Commercial Bank and Agricultural Development Bank), two Rural Banks as well as some micro financial institutions that provide credit to the general public.

On education, the assembly has 59 pre-schools, 61 Primary Schools, 30 Junior Secondary, 3 Senior Secondary Schools, one Technical Institute and one Vocational School, this number covering both private and public schools (GSS, 2014b).

3.2 METHODOLOGY

3.2.1 Selection of study sites

The forest-savannah transitional zone was selected based on its uniqueness for smallholder food crop production.

The two districts of Kwahu Afram Plains North and Kpando Municipality were selected based on preliminary consultations with officials and stakeholders at the district and regional levels that revealed that the two falls within the zone (see Figure 3.1) and were found to be significant food crop producers. The two districts are also strategically placed adjacent to the Volta Lake with both men and women actively involved in smallholder farming.

In all, two districts (Kwahu Afram Plains North district and Kpando Municipality), with four (4) communities each and a total of forty five (45) farming settlements (names of settlements attached as appendix E) were selected. The various farming communities identified formed the sample frame and simple random sampling technique was used in selecting four farming communities from each district. In Kpando Municipality for

example, twenty two farming settlements were sampled from Torkor, Kpando, Gbefi, and Sovie Kudra communities (Table 3.1). Similarly, in the Kwahu Afram Plains North district (KAPND), 23 farming settlements were sampled from Donkorkrom, Mimchemfre, Amankwaakrom and Abotanso communities (Table 3.1).

Table 3.1: Selected communities of the study by geographical locations and their sample sizes.

Region/ Location	District	Community	No. of Farming Settlement
Eastern (In front of Lake)	Kwahu Afram Plains North	• Donkorkrom	6
		• Mimchemfre	5
		• Amankwaakrom	5
		• Abotanso	7
		Total	23
Volta (Behind the Lake)	Kpando Municipality	• Gbefi	3
		• Sovie Kudra	5
		• Kpando Central	9
		• Torkor	5
		Total	22
		Grand Total	45

Source: Fieldwork, 2016

3.2.2 Choice of methodology

The study used both quantitative and qualitative methods which feminist geographers have often used to tease out gender-sensitive concerns. Mixed method combines the strengths of both quantitative and qualitative research and aids in understanding complex problems which either approaches (quantitative or qualitative) are unable to unravel (Creswell, 2009; Teye, 2012). The approach serves a useful purpose of complementarity where elaboration and clarification of results of one method could be sought with the results from the other methods (Johnson & Onwuegbuzie, 2004; Teye, 2012). Further,

vulnerability research can combine quantitative and qualitative approaches where the subjective world of diverse human perceptions, values, and cultures could well be explored alongside (McLaughlin & Dietz, 2007).

The mixed method approach resonates with the pragmatic philosophical assumptions of combining quantitative and qualitative modes of enquiry (Creswell, 2009). The approach supports inclusion and challenges oppressive social structures. It is used extensively for marginalized groups and thus useful in achieving the study's objectives – that is assessing the gender concerns of smallholder farmers' agricultural livelihoods. In addition, knowledge from epistemological and methodological issues in climate change vulnerability and smallholder agriculture has emerged with both structural and agency limitations that should be assessed with the right research tools. This makes the linkage of structuration theory, pragmatism and gender approaches very applicable in the design and implementation of an academic research of this kind.

The quantitative method resonates with the positivist paradigm where science is noted to be neutral and objective and value-free (Teye, 2012). As a result, the quantitative method was used to derive information that were quantifiable and could thus be generalized (Castro et al., 2010; Teye, 2012; Creswell, 2014). In the context of this study, the quantitative approach assessed gender differentials in the effects of climate change and adaptation among smallholder farmers and also established patterns and trends from responses of respondents. In addition, some statistical tests were computed to test for causalities and also establish relationships between certain selected variables.

Conversely, the qualitative method was used to give in-depth report on the perceptions, experiences, attitudes, emotions and behaviour of the respondents regarding the impacts of the climatic changes experienced by the target population and how they adapt.

Qualitative approach resonates with the interpretivist paradigm where much significance is given to subjective interpretation. Given the complex nature of social reality, the perspective of the social actor is given much priority in qualitative research (Creswell, 2014). Thus, an individual's perspectives and interpretation of climate change and variability could be thoroughly examined via qualitative research. In view of this, the mixed method approach was adopted to achieve the objectives of the study.

The method is selected based on the study's adopted Structuration theoretical / philosophical perspective (Giddens, 2013) that provides a bridge between subjectivism (constructivist) and objectivism (positivist) in the social sciences. The approach provides opportunities for the integration of a variety of theoretical perspectives (e.g., ecological theories, complexity theory critical theories, or others). The salient strength of qualitative and quantitative would be combined for an effective synergic benefits in answering research questions and at the same time minimise the weaknesses of an individual method alone.

3.2.3 Data Sources

To achieve the study's objectives, both secondary and primary data sources were relied on.

3.2.3.1 Secondary data sources

Secondary data were sourced from books, journal articles, institutional reports (e.g. Ghana Statistical Service, Meteorological Department, MMDAs etc.), magazines, thesis reports and other publications related to gender, climate change and variability, agriculture and farmers vulnerability amongst other. Data on climatic variables such as temperature, rainfall and humidity were obtained from the Ghana Meteorological Department, articles and district assembly.

3.2.3.2 Primary data sources

The primary data for the study were from quantitative and qualitative data sources. The methods used in obtaining the data was questionnaires for quantitative; and interviews, focus group discussions (FGDs), participatory scenario mapping/planning (PSP) using indigenous knowledge and observation for the qualitative. The qualitative method assisted in the in-depth assessment of climate change impact on women and men smallholder farmers in the target area.

3.2.3.2.1 Household Questionnaire

The household questionnaire targeted male and female smallholder farmer household heads. This included respondents who were more than 18 years and farmers, that is, those who have been farming for more than five (5) years were the major target group. This was because such respondents are likely to have experienced as well as been exposed to the effects of climate change to some extent. Questionnaire administrations were mostly undertaken in homes of respondents, on their nearby farms after initial contacts had been made and some public places including schools. To have a fair representation, the survey were carried out in the rural farming settlements around all the four major communities in each district namely Abotanso, Amankwaakrom, Donkorkrom, and Mimchemfre for Kwahu Afram Plains North District; as well as Torkor, Kpando, Gbefi, and Sovie Kudra for Kpando Municipality.

The questionnaire was in five sections including background characteristics of respondents, climate change awareness and perceptions among farmers, effects of climate change, climate change adaptation, and institutional service provision. This was to aid in soliciting information on respondent's household demography, awareness and perception of climate change, effects of climate variability and change on local livelihoods,

adaptation and coping strategies, and availability of and accessibility to institutional services. In instances where household heads and farmers could not read and write properly, the researcher and her trained research assistants explained and filled questionnaires for respondents. The instruments were pretested at two farming settlements namely Dedeso and Odumase around Tease community in Kwahu Afram Plains South. The area had similar physical, social and economic characteristics and was also within the forest-savannah transitional zone. This gave room for certain clarifications, rephrasing of certain questions, identifying local names of certain crops, tree species and other weeds which were hitherto not known to the researcher before the actual commencement of the survey. In all, a total of 606 respondents were sampled for the survey. This comprised of 308 respondents with 157 males and 151 females from Kpando Municipality and 298 with equal number of 149 respondents for both males and females from Kwahu Afram Plains North District (see Table 3.2).

Table 3.1: Selected communities of the study by geographical locations and their sample sizes.

Region/ Location	District	Community	No. of Farming Settlement	Pop Frame –Households	Sample size	
					M	F
Eastern (In front of Lake)	Kwahu Afram Plains North	Donkorkrom	6	2,204	M	F
		Mimchemfre	5		149	149
		Amankwaa-krom	5			
		Abotanso	7			
		Total	23		298	
Volta (Behind the Lake)	Kpando Municipality	Gbefi	3	2,654	M	F
		Sovie Kudra	5		157	151
		Kpando Central	9			
		Torkor	5			
		Total	22		308	
		Grand Total	45	4,858	606	

Source: Fieldwork, 2016

3.2.3.2.1.1 Sampling Technique

Given the fact that the various farming communities in each district have been identified and sampled (see section 3.2.1), a simple random sampling method was used in selecting the various households for the questionnaire survey. This involved the identification and listing of the farming households in each community by numbers. The numbers were folded and placed in a bowl and one was drawn at a time after a vigorous shake up. After sampling of the various communities for the survey, each community was delineated into three Enumerated Areas (EA) based on the settlement pattern out of which one was randomly selected. Each dwelling unit within each EA was numbered and listed for selection. This formed the sample frame for each community sampled. Thereafter, a simple random sampling method was employed to select a household for the survey. This was mostly the case in circumstances where more than one household occupies a dwelling unit or house. However, in situations where there is one household in a dwelling unit, the head of the household was interviewed. To ensure fair representation of male and female headed households, a stratified random sampling method was employed. In view of this, male headed households were listed separately from the female headed households. While this was done to ensure fair representation, one cannot overlook the fact that most of the households in Ghana are mostly male headed and thus there is the likelihood of selecting more males than females. The study gives much cognisance to the fact that this could constitute a weakness of the study, especially when the study aims to ascertain gender differences in climate change awareness, effects and adaptation. However, in some communities like Abotanso and Mimchemfre in Kwahu Afram Plains North district, most of the households were headed by females. In some of these communities where the household were hitherto male-headed, the males had either migrated or dead or the couple were separated or divorced. This could explain why some of the households in these

communities were headed by females. In all, a total of 606 households were selected with 298 households from KAPND and 308 from Kpando Municipality. It covered 149 respondents equally for both males and females in the KAPND; and 157 males with 151 females' respondents for Kpando Municipality (see Table 3.1). Respondents consented to take part in the questionnaire survey and were forthcoming with responses, especially on issues of awareness and adaptation.

3.2.3.2.1.2 Fieldwork and training of Field Assistants

The field work took place between March and July, 2016 for the two districts. However, reconnaissance survey was done in May, 2015. For the researcher to get first-hand information and deeper understanding about respondents' feelings/views about climate change, she conducted all the FGDs and in-depth interviews herself. However, the researcher solicited the support of five (5) field assistants for the administration of the household questionnaires. They were MOFA and agricultural extension officers who lived in the communities, were already working with the farming communities and had rich experience in field research. They spoke the various local languages and were easily accepted by the people because they have been mobilizing farmers for Farmer's Days and for other governmental and NGO programmes.

Research Assistants were taken through a day's induction/orientation on the questionnaire in each district capital. They were taken through the questionnaires for the study page by page. The sample selection, sample size and choice of locations, best times to meet who and where, the appropriate language and protocols were fully discussed at the training. The local words or terms for difficult concepts/terms like 'climate change' and 'gender' were discussed and agreed upon for better understanding. The survey was done mostly in Twi and occasionally in English, especially in circumstances where the respondents had

higher level of education and thus felt very comfortable communicating in English. There was a question and answer session that provided an opportunity for clarification of issues. Women felt more comfortable with female agricultural extension officers including myself, especially with the uneducated female farmers. Interestingly, it was observed that men farmers rather seem to feel more comfortable with women and could also go on well with men officers. Some omissions and inconsistencies observed were rectified to improve the data quality for the study.

3.2.3.2.2 Focus Group Discussions (FGDs)

In total, 24 FGDs were held with 12 FGDs for each district and 3 for each community (see Table 3.3). The number of participants for the FGDs ranged between 6 and 8. The grouping consisted of at least, one female only, one male only and one mixed group comprising of both male and female farmers for each community. The focus group discussions (Plate 3.1) allowed individual farmers to have the opportunity to share their knowledge and experiences in detail in smaller groups.

Plate 3.1: A focus group discussion with selected women farming leaders in the Kwahu Afram Plains North district.



Source: Fieldwork, 2016

The interviews were conducted separately with an interview guide for in-depth discussions to encourage respondents of the same sex to express themselves freely. The interview guide were in two forms, one for the FGDs and interviews and the other for the various institutions such as Ministry of Food and Agriculture (MOFA), agricultural extension officers, forestry and meteorological officers, NGOs, CSOs, agro input dealers. The interview guides captured issues of climate change awareness and perceptions, the effects of climate change, adaptive measures to climate change effects and the kinds of support various institutions provide in mitigating or coping with climate change effects.

Table 3.3: Selected communities and FGDs sampled for the study.

Region/ Location	District	Community	No. of Farming Settlement	FGD size
Eastern (In front of Lake)	Kwahu Afram Plains North	Donkorkrom	6	F = 8 M= 6 A = 8
		Mimchemfre	5	F = 8 M= 6 A = 8
		Amankwaa-krom	5	F = 8 M= 8 A = 8
		Abotanso	7	F = 8 M= 6 A = 7
		Total	23	89
Volta (Behind the Lake)	Kpando Municipal Assembly	Gbefi	3	F = 8 M= 6 A = 7
		Sovie Kudra	5	F = 6 M =6 A =8
		Kpando Central	9	F = 6 M= 6 A = 8
		Torkor	5	F = 8 M= 8 A = 8
		Total	22	85
		Grand Total	45	174 = 737

Source: Fieldwork, 2016

Note: F=Female; M=Male; A=All or Mixed Group.

Farmers with over five (5) years farming experience were purposively selected for interviews since they were well-positioned to give in-depth responses due to their experiences and long exposure to varying climatic conditions over the years. Various questions were used to ascertain whether these farmers had noticed long-term changes in mean temperature, mean rainfall, and vegetation cover losses over the years. Questions about adaptation and constraints to adaptation were also posed. In some instances, questionnaires were used as guides to capture responses and direct the line of questioning.

The FGD sessions were often held in the homes of one of the participants, with a few held under trees or nearby classrooms. Pertinent issues regarding respondents' perceptions, effects of climate change on local agricultural activities, adaptation and coping strategies, availability and access to institutional support and gender differentiation issues were probed.

3.2.3.2.3 In-depth interviews

In-depth interviews were also conducted for selected leaders of government agencies and key developmental NGOs including the Municipal Chief Executive of Kpando Municipal Assembly, the District Co-ordinating Directors of the two (2) District Assemblies, Departmental heads of the MoFA, Forestry and Wildlife Departments of the Forestry Commission, Office of Administrator of Stool Lands (OASL) etc. The heads of selected NGOs including the Afram Plains Development Organization (APDO) were also interviewed. This was to solicit information on policies, programmes and projects being implemented to address farmers' climate change challenges. In-depth interviews were also held with traditional authorities including queen-mothers to discuss issues on land tenure, access and control of land of farmers, history and trend of climatic changes as well as their experiences and concerns. In addition to this, agro-input dealers and food crop sellers among others were interviewed because they were farmers themselves as well as selling their produce or essential fertilizers /chemicals critical for higher yields under the changing climatic conditions.

3.2.3.2.4 Participatory Scenario Planning (PSP)

A Participatory Scenario Planning (PSP) tool using indigenous knowledge was used to map and assess the effects of climate changes on the lives of farmers. It enabled the exploration of possible future climatic changes or variability assessments and

accompanying impacts to enhance locally suitable adaptation strategies (Flynn et al., 2018). Active involvement in processes to facilitate shared understanding of future risk conditions, vulnerabilities, opportunities and potential impacts were undertaken to enable qualitative data acquisition.

3.2.3.2.5 Observation

Exploratory techniques like observation and informal discussions with smallholder farmers, chief farmers, opinion leaders, and food crop sellers were also used. Observation was used as a non-verbal means of collecting quality information from the target groups. It involved watching and taking notes as respondents shared their experiences either individually or in groups. In addition, the immediate surroundings were closely observed including the vegetation, land, rivers, farms, the weather and how their day-to-day activities were undertaken. It was done personally in all the selected communities in the two districts to observe how the climatic variability affected physical features, behaviour and attitudes, beliefs, farmers' social relations and their livelihood activities as male or female farmers.

In addition, informal discussions were held alongside the observation with farmers, opinion leaders, and community members for clarifications and deeper understanding of issues.

3.2.3.3 Field Experiences

The fieldwork was very educative, informative, and worth the effort, but there were a few challenges. Some respondents reported that they were tired of the many researchers trooping the area with interviews without any support for them. As a result, they were initially apathetic. They however, started cooperating when the purpose of the study was carefully explained to them. Some respondents felt reluctant to disclose their earnings

from the farming produce, and it was observed that, in most cases, they had difficulty determining and quantifying their earnings. Some explained that their earnings were not regular and were spent or reinvested in other business activities immediately. It was found that most of the people in KAPND, for instance, were migrants who could speak Ewe, Ga-Dangbe, Ga, Twi and some amount of English. Interestingly, language ceased to be a problem after they understood the purpose of the study.

Using the local agricultural extension staff was a big advantage because the farmers were already working with them in the field so the trust, acceptance and cooperation was very high. They could speak all the native languages and better understood their culture. One can argue that this has the tendency to influence the responses given by farmers, especially in situations where they are expected to critique the various institutions. However, the researcher made sure such situations are avoided and so all the interviews and FGDs were conducted by the researcher.

Making appointments with some officials was a bit frustrating. Some governmental/NGO officials were always busy and had to reschedule appointments for many times. A few at the end delegated their assistants to meet me. The opinion leaders like chiefs, queen-mothers, assembly men/women, chief farmers often kept the appointment and warmly welcomed researchers into their homes or their own proposed venues. It was also realised that meetings with women were preferred in the evening after cooking or early in the morning before going to farm because of their multiple roles that kept them constantly busy. In a few cases, researchers had to follow respondents to their farms especially those involved in group farming. Through perseverance and commitment, the in-depth interviews and FGDs were successfully conducted.

3.3 DATA ANALYSIS

The quantitative data were analysed using the Statistical Package for the Social Sciences (SPSS) version 20. The data were manually coded and entered into SPSS and summary results of key variables were generated using the frequency and percentages. Variables analysed in this way included socio-demographic characteristics of respondents, farmers' perception and awareness of climate change/variability, perceived effects on smallholder farmers including physical, social and psychological effects and adaption strategies employed in dealing with this phenomenon. Again, the data were disaggregated along gender and district levels, thus allowing for gender and district comparison. The presentations of the findings were either in tables or charts using bar graphs or pie charts. Even though statistical tools like T-test, ANOVA and Man-Whitney U-test are used to perform tests of significance, it should be noted that the choice of any of these depends on the purpose of the analysis and the scale of measurement of the variables. With respect to the test of statistical significance for this study, the chi-square (χ^2) test of independence was used.

In the case of this study, most of the variables used were nominal and therefore made the use of chi-square test most appropriate. Statistical difference was examined between variables such as gender and awareness of climate change, gender and perceived effects of climate change/variability and gender and various effects (physical, psychological and social). Binary logistic regression analysis was used in predicting climate change and variability awareness.

The qualitative component from focus groups and in-depth interviews were read through several times via systematic steps and processes that focused on transcribing interviews, familiarization of data, selection of data set from data, building categories, grouping under thematic areas, coding ideas, manual analysis, refined and raw categorized data

quotations, and these were cited according to the majority views. Summary interpretations were used to support quantitative analysis. Photographs, flow charts and other visual approaches were used to illustrate various situations and observations.

3.4 ETHICAL CONSIDERATIONS

The research met the ethical considerations and requirements of University of Ghana, Legon which included consent procedures covering confidentiality, privacy, risks and benefits. In terms of confidentiality, anonymity and privacy, the research did not demand names and addresses of respondents. All the responses received were used for the purposes of the research alone and all respondents were allowed to decide whether they wished to participate in the research or not. It was made clear to the respondents that they had the right to decide whether or not to answer any question, and the fact that, they should feel free to decide on what and which information they desire to disclose. Respondents were assured that the research was purely for academic purposes and as such their participation would enhance success of the study. As much as possible they were assured that deception was impossible, even if some other researchers have deceived them before.

In acquiring trustworthy data, four key areas considered were credibility, confirmability, dependability and transferability. To gain credibility from respondents, the researcher respected the rights, needs, values and desires of the informants throughout the study. The researcher convinced respondents that the study was solely for academic research and not for profit. Further, all discussions including focus group and interviews were recorded and cross-checked for validity. In relation to conformability; the issue of neutrality or the extent to which research findings are based on respondents but not researchers' bias,

motivation and interest was critical. The data was recorded and presented as accurately as possible portraying the views of respondents.

With regards to dependability, leaders for FGDs were contacted for verification and confirmation of issues that were not clear about the results during validation sessions. Finally, the researcher ensured that the coding and categorization of data captured the contextual, thematic and descriptive elements vividly for consistency and possible future work repetition. The researcher provided detailed description of key words like ‘climate change’, ‘gendered vulnerability’ so that respondents could understand and contribute effectively to discussions; and for it to be transferrable to other settings and situations (Holloway, 1999).

3.5 SUMMARY

The chapter provided description of the study area and specific communities in which the study was undertaken. It described their characteristics such as vegetation, climate, and demography as well as issues pertaining to the local economy and social infrastructure. It further discussed the methodology in relation to sampling, data collection and analytical tools used. The selection of the mixed method approached was informed by Giddens’ philosophical perspective adopted by the study. It bridges the gap between the post positivist (objectivist) and social constructivist (subjectivist) worldviews in research methodology. In addition, it reflected on the ethical values incorporated into the studies.

CHAPTER FOUR

BACKGROUND CHARACTERISTICS OF RESPONDENTS, PERCEPTION AND AWARENESS OF CLIMATE CHANGE AND VARIABILITY

4.1 INTRODUCTION

This chapter presents the analyses of the field data based on socio-economic characteristics of respondents; the farming characteristics of respondents; and perception on climate change and variability in the two districts. The first section presents the background characteristics of respondents including sex, age, marital status, level of education and religion. In addition, the background characteristics of respondents in relation to years of farming, farm size, location of farms and the major crops respondents cultivate are also discussed. The second section also discusses the perceptions of respondents about climate change and variability. This includes climate change and variability awareness, major sources of information pertaining to climate change and variability, perceived significant climatic and environmental changes, and causes of these climatic changes. These analyses were performed in relation to study site and sex.

4.2 BACKGROUND CHARACTERISTICS OF RESPONDENTS

Out of the total number of respondents sampled (606), 50.5 percent were males and 49.5 percent were females. With respect to the 308 respondents sampled in Kpando Municipality, 51 percent were males and 49 percent were females. In KAPND, out of the 298 respondents sampled, there were equal percentage of males and females (see Table 4.1). In terms of age of the total respondents sampled, 28.7 percent and 26.9 percent were within the ages of 31-40 years and 41-50 years respectively while those within the ages 61 years and above (8.4%) and 20 years and below (1.0%) were the least represented age group in the sample. In both districts for instance, a higher percentage of respondents

were within the ages of 31-40 years (33.6 percent) and 41-50 years (27.3 percent) respectively (see Table 4.1). This suggests that majority of smallholder farmers who were household heads and within the active age group were within this age group (31-50 years). This result is in consonance with the report by FAO which stated that farming continues to be an unattractive occupation for the youth, mostly those within 18-30 years and not in school, but rather seen as an occupation for the aged especially in rural areas (FAO, 2012).

Table 4.1: Socio-demographic characteristics of respondents

Background Characteristics	KAPND n= 298		KpMu n= 308		Both (KAPND & KpMu)		Total N=606 (100.0%)
	Male n= 149 (50%)	Female n=149 (50%)	Male n=157 (51.0%)	Female n= 151 (49.0%)	Male n= 306 (50.5%)	Female n= 300 (49.5%)	
Age (years)							
20 and less	0 (0.0%)	1 (0.7%)	4 (2.5%)	1 (0.7%)	4 (1.3%)	2 (0.7%)	6 (1.0%)
21-30 years	14 (9.4%)	14 (9.4%)	25 (15.9%)	30 (19.9%)	39 (12.7%)	44 (14.7%)	83 (13.7%)
31-40 years	50 (33.6%)	50 (33.6%)	35 (22.3%)	39 (25.8%)	85 (27.8%)	89 (29.7%)	174 (28.7%)
41-50 years	39 (26.2%)	40 (26.8%)	44 (28.0%)	40 (26.5%)	83 (27.1%)	80 (26.7%)	163 (26.9%)
51-60 years	32 (21.5%)	36 (24.2%)	35 (22.3%)	26 (17.2%)	67 (21.9%)	62 (20.7%)	129 (21.3%)
61 and Above	14 (9.4%)	8 (5.4%)	14 (8.9%)	15 (9.9%)	28 (9.2%)	23 (7.7%)	51 (8.4%)
Marital Status							
Single	24 (16.1%)	23 (15.4%)	30 (19.1%)	31 (20.5%)	54 (17.6%)	54 (18.0%)	108 (17.8%)
Married	112 (75.2%)	96 (64.4%)	122 (77.7%)	96 (63.6%)	234 (76.5%)	192 (64.0%)	426 (70.3%)
Divorced	4 (2.7%)	15 (10.1%)	4 (2.5%)	11 (7.3%)	8 (2.3%)	26 (8.7%)	34 (5.6%)
Widowed	2 (1.3%)	8 (5.4%)	1 (0.6%)	13 (8.6%)	3 (1.0%)	21 (7.0%)	24 (4.0%)
No response	7 (4.7%)	7 (4.7%)	0 (0.0%)	0 (0.0%)	7 (2.3%)	7 (2.3%)	14 (2.3%)

Level of Education							
No Education	26 (17)	34 (22.8%)	18 (11.5%)	24 (15.9%)	254 (83.0%)	254 (84.7%)	102 (16.8%)
Non formal	25 (16.8%)	23 (15.4%)	13 (8.3%)	16 (10.6%)	38 (12.4%)	39 (13.0%)	77 (12.7%)
Basic	75 (50.3%)	68 (45.6%)	61 (38.9%)	68 (45.0%)	136 (44.4%)	136 (45.3%)	272 (44.9%)
Secondary	12 (8.1%)	13 (8.7%)	57 (36.3%)	33 (21.9%)	69 (22.5%)	46 (15.3%)	115 (19.0%)
Tertiary	5 (3.4%)	5 (3.4%)	7 (4.5%)	10 (6.6%)	12 (3.9%)	15 (5.0%)	27 (4.5%)
Others (Voc/Tec)	6 (4.0%)	6 (4.0%)	1 (0.6%)	0 (0.0%)	7 (2.3%)	7 (2.3%)	14 (2.3%)
Religion							
Christian	127 (85.2%)	121 (81.2%)	277 (90.5%)	265 (88.3%)	277 (90.5%)	265 (88.3%)	542 (89.4%)
Muslim	12 (8.1%)	15 (10.1%)	16 (5.2%)	17 (5.7%)	16 (5.2%)	17 (5.7%)	33 (5.4%)
Traditional	2 (1.3%)	3 (2.0%)	4 (1.3%)	8 (2.7%)	4 (1.3%)	8 (2.7%)	12 (2.0%)
Others	1 (0.7%)	3 (2.0%)	2 (0.7%)	3 (1.0%)	2 (0.7%)	3 (1.0%)	5 (0.8%)
No response	7 (4.7%)	7 (4.7%)	7 (2.3%)	7 (2.3%)	7 (2.3%)	7 (2.3%)	14 (2.3)

Source: Fieldwork (2016)

Moreover, Table 4.1 shows that majority of respondents were married (70.3%) compared to those who were single (17.8%), divorced (5.6%) and widowed (4.0%). Comparatively, more females (76.5%) than males (64.0%) were married in both districts. In addition, more females (8.7%) were divorced than males (2.3%) and also more females (7.0%) than males (10.%) were widowed. It was found that, marriage as a social institution continues to be very relevant in Ghanaian societies especially in rural communities. While it is important for procreation, it is also seen as a means of getting a helping hand (either man or woman) in managing both household affairs and other livelihood activities especially farming. Relatively, a higher percentage of respondents in KpMu were either married or single than those in KAPND (see Table 4.1).

With regards to the level of education of respondents, 44.9 percent had attained basic level of education, 19 percent, secondary education, and 4.5 percent had received some form of tertiary education. On the other hand, 16.8 percent and 12.7 percent had received no education and no formal education respectively. Even though the results suggest that more of respondents from both KAPND and KpMu indicated that they had received some basic education, a higher percentage of those from KAPND (48%) had received basic education than those in KpMu (41.9%). Also, though the results shows that there are no variations in respondents' highest level of education in terms of sex, more males (22.5%) had attained secondary education than females (15.3%). Also, 2.3 percent had attained vocational or technical education. Given the fact that majority of respondents sampled had acquired some form of basic education, one could assume that there would be no difficulty for farmers to read and access basic information on climatic changes on their own as well as adopt good agronomic practices with least efforts from agricultural extension officers. In addition, a higher percentage of respondents from KpMu (29.2%) had received secondary education than those from KAPND (8.4%).

In terms of religious affiliations, majority of respondents were Christians (89.4%) compared to 5.4 percent who were Muslims. Only 2 percent of respondents sampled were traditionalist. This indicates that Christianity is the major religion within the selected districts. Comparatively, a greater percentage of respondents from both KpMu (95.5%) and KAPND (83.2%) were Christians.

Table 4.2 also presents the results of the field data based on the characteristics of respondents' primary occupation (farming) including years of farming, farm size, geographic location of farms and the major crops they cultivate. This was done in relation to study areas (KAPND & KpMu) and sex. Out of the 606 respondents sampled, majority (70.1%) indicated that they have been farming for more than 9 years, followed by those

who have been farming for 4-6 years (13.2%), while 0.5 percent have been farming for less than a year. Comparatively, more females have been farming for more than 9 years than males (see Table 4.2). In terms of the size of farms, a higher percentage of respondents have 4-6 acres (37%) and 1-3 acres (35.6%) of farm lands respectively. On the other hand, only 2.1 percent indicated that they have less than one acre of farm lands. In addition, more females (61.7%) have 1-3 acres of farm land than males (52.3%) in KAPND; however more males (35.6%) have 4-6 acres of farm land than females (25.5%) in Kpando Municipality.

Table 4.2: Background characteristics of respondents in relation to farming Activities

Background Characteristics (Farming)	KAPND n= 298		KpMu n= 308		Both (KAPND & KpMu)		Total N=606
	Male n= 149	Female n=149	Male n=157	Female n= 151	Male n= 306	Female n= 300	
Years of Farming							
Less than 1 year	1 (0.7%)	2 (1.3%)	0 (0.0%)	0 (0.0%)	1 (0.3%)	2 (0.7%)	3 (0.5%)
1-3 years	16 (10.7%)	8 (5.4%)	6 (3.8%)	6 (4.0%)	22 (7.2%)	14 (4.7%)	36 (5.9%)
4-6 years	19 (12.8%)	15 (10.1%)	26 (16.6%)	20 (13.2%)	45 (14.7%)	35 (11.7%)	80 (13.2%)
7-9 years	18 (12.1%)	23 (15.4%)	9 (5.7%)	12 (7.9%)	27 (8.8%)	35 (11.7%)	62 (10.2%)
Above 9 years	95 (63.8%)	101 (67.8%)	116 (73.9%)	113 (74.8%)	211 (69.0%)	214 (71.3%)	425 (70.1%)
Farm Size							
Less than 1 acre	0 (0.0%)	7 (4.7%)	5 (3.2%)	1 (0.7%)	5 (1.6%)	8 (2.7%)	13 (2.1%)
1-3 acres	78 (52.3%)	92 (61.7%)	21 (13.4%)	25 (16.6%)	99 (32.4%)	117 (39.0%)	216 (35.6%)
4-6 acres	53 (35.6%)	38 (25.5%)	65 (41.4%)	68 (45.0%)	118 (38.6%)	106 (35.3%)	224 (37.0%)

7-10 acres	5 (3.4%)	7 (4.7%)	56 (35.7%)	49 (32.5%)	61 (19.9%)	56 (18.7%)	117 (19.3%)
More than 10 acres	12 (8.1%)	5 (3.4%)	7 (4.5%)	5 (3.3%)	19 (6.2%)	10 (3.3%)	29 (4.8%)
Don't know	1 (0.7%)	0 (0.0%)	3 (1.9%)	3 (2.0%)	4 (1.3%)	3 (1.0%)	7 (1.2%)
Location of Farms							
Within the District	144 (96.6%)	144 (96.6%)	110 (70.1%)	110 (72.8%)	254 (83.0%)	254 (84.7%)	508 (83.8%)
Outside the District	5 (3.4%)	5 (3.4%)	47 (29.9%)	41 (27.2%)	52 (17.0%)	46 (15.3%)	98 (16.2%)
Major Crops Cultivated							
Cereals	120 (80.5%)	121 (81.2%)	147 (93.6%)	142 (94.0%)	267 (87.3%)	263 (87.7%)	530 (87.5%)
Vegetables	6 (4.0%)	2 (1.3%)	5 (3.2%)	5 (3.3%)	11 (3.6%)	7 (2.3%)	18 (3.0%)
Root Tubers	19 (12.8%)	24 (16.1%)	5 (3.2%)	4 (2.6%)	24 (7.8%)	28 (9.3%)	52 (8.6%)
Fruits	4 (2.7%)	2 (1.3%)	0 (0.0%)	0 (0.0%)	4 (1.3%)	2 (0.7%)	6 (1.0%)

Source: Fieldwork (2016)

Moreover, Table 4.2 also shows that majority of respondents (83.8%) have farms within the selected district whereas 16.2 percent have farm lands outside the district. It was observed that KAPND practices matrilineal inheritance, and women traditionally could inherit land and property equally as their male counterparts. Yet there is an inherent inequality in inheriting lands by women because it was realised that most of the lands were under male control and a lot of women inheritors (most senior in the hierarchy traditionally) often permit young male relatives to run errands on the land on their behalf, which grants those males a better insight into the affairs of the lands. The matrilineal practice indeed offers women farmers the opportunity to access and control sizable

amount of fertile lands for farming. This is contrary to what Yaro observed in the northern region of Ghana, where patrilineal system of inheritance is practiced (Yaro, 2012) and women's access and control of fertile lands for farming traditionally is so limited or restricted. Regardless of the fact that Kpando Municipality practices a patrilineal system of inheritance, it was observed that women have higher access to land use almost equal to men than in northern Ghana (Yaro, 2012). Consequently, most women respondents hardly experienced any discrimination on land use in the area. Interestingly, farmers in the KAPND are mostly settlers who have bought plots of land on their own or are renting on 'work and share bases'. As such, most of the female farmers control the plots of lands they were farming on and could therefore take adaptive decisions on their own. However, it was found that, their farm sizes were not as large as their male counterparts. It was found that, traditionally, the Chiefs of Abitififi, Nkwatia, Bukuruwa and Pitiko own the KAPND lands. Thus, indigenes of these towns could come and farm seasonally and go back to their places of residence and own other farms as well. In addition, the results presented in Table 4.2 also indicate that 87.5 percent of respondents cultivate cereals, 8.6 percent cultivate root tubers and only 3 percent are into vegetable farming, which suggests a prominence of cereal farming in the two districts (KAPND & KpMu). However, in spite of the absence of irrigation to support all year round vegetable cultivation in the area, the presence of ready market coupled with the high profit associated with vegetable cultivation have motivated small farmer's groups to go into active vegetable cultivation. These groups have adopted some irrigation measures such as digging of ponds/ dams for vegetable cultivation in both districts. Vegetable farming, which hitherto was seen as women's activity is now being taken over by men. This is largely because they mostly have the financial strength to buy the pumping machines and the business turn-over is moreover higher compared to the cereals.

Comparatively, a higher percentage of both male and female respondents from KAPND cultivate root tubers than those in KpMu (Table 4.2). The root crop ‘cassava’ is a preference to KAPND smallholder farmers because of its ability to withstand the bad weather and cannot be totally destroyed during bush-fires and cattle rampage /grazing. Again, it could be left to stand in the field unharvested for some time until there is a ready market or use for it. Also, none of the respondents sampled in KpMu cultivates fruits as a major crop as compared to those sampled in KAPND.

4.3 GENDERED AWARENESS OF CLIMATE CHANGE AND VARIABILITY IN KAPND AND KPMU.

Central to how individuals respond, cope or adapt to a risk or any hazard is the perception or awareness about that phenomenon. Certainly, how people perceive an event has a significant influence on how they adapt or respond to such events (Maddison, 2006; Gbetibouo, 2009). It would also suffice to add that knowledge and awareness about a phenomenon mirror the perception held about it and thus influence attitudes towards it (Boko et al., 2007; Falaki et al., 2013). In view of this, one of the key objectives of the study was to examine the perceptions held by respondents of KAPND and KpMu about climate change and variability. This was examined in relation to sex between the two selected study sites (KAPND & KpMu). Cross tabulations and chi square test of association were computed to assess the relationship between sex and climate change and variability awareness across the two districts selected. The results of this analysis are presented in Table 4.3.

Out of the 606 respondents sampled, 83.2 percent indicated that they were aware of climate change and variability whereas 16.8 percent were not aware. With regards to

gender variations in climate change and variability awareness, a chi square test showed a significant relationship between sex of respondents and climate change and variability awareness ($p=0.0001$), given the fact that majority of males (98.0%) were aware of changes in climatic conditions than females (68.0%) in both districts. Alternatively, more females (32%) were not aware of climate change and variability as compared to males (2%). Studies have revealed that no farmer regardless of their sex can adapt effectively if they do not understand and appreciate the realities about the changing climate (Boko et al., 2007; Falaki et al., 2013). The findings of this study indicate that males are more likely to be aware of climate change and variability than females and this could be attributed to the finding that the higher literacy level (basic education) of males which implies the possibility of reading and accessing information on their own. It was also observed that men had more confidence and time in seeking information from MOFA extension officers, peer group members, neighbours, radio and other sources on climatic changes and how it was affecting their farming activities than women farmers.

Table 4.3: Relationship between climate change/variability awareness and sex in KAPND & KpMU

Study site	Sex	Climate change/Variability Awareness		Total
		Aware	Not Aware	
KAPND	Male	143 (96.0%)	6 (4.0%)	149 (100.0%)
	Female	106 (71.1%)	43 (28.9%)	149 (100.0%)
	Sub-total	249 (83.6%)	49 (16.4%)	298 (100.0%)
$\chi^2=33.44$, df (1), p value= 0.0001<0.05				
KpMu	Male	157 (100.0%)	0 (0.0%)	157 (100.0%)
	Female	98 (64.9%)	53 (35.1%)	151 (100.0%)
	Sub-total	255 (82.8%)	53 (17.2%)	308 (100.0%)
$\chi^2=66.559$, df (1), p value= 0.0001<0.05				
Both (KAPND & KpMu)	Male	300 (98.0%)	6 (2.0%)	306 (100.0%)
	Female	204 (68.0%)	96 (32.0%)	300 (100.0%)
	Total	504 (83.2%)	102 (16.8%)	606 (100.0%)
$\chi^2=97.65$, df (1), p value= 0.0001<0.05				

Source: Fieldwork (2016)

It is therefore not surprising that the results of the analyses at the various study sites mirrors the total responses. For instance, all the male respondents sampled in KpMu indicated that they were aware of climate change and variability as compared to females (see Table 4.3). Thus, the chi square test shows a significant relationship between sex and climate change and variability awareness in KpMu ($P<0.01$). The case of KAPND is no exception considering the fact, majority of males (96.0%) than females (71.1%) indicated that they were aware of climate change and variability. Again, the chi square test shows that a significant relationship exists between sex and awareness of changes in climatic conditions in KAPND ($p<0.01$) (see Table 4.3)

In establishing the relationship that exist between the awareness between the sexes, it was observed that women's vulnerability is influenced by societal norms that has been developed through socialisation over time. This makes women face different conditionalities in society that should be considered accordingly (Batan & Khan, 2010). Hence climatic induced hazards like drought and erratic rainfall often cause women farmers to work extra hard to look for potable water and firewood for survival. The difficulty women face in getting vegetables and medicinal shrubs from backyard for soup and for healing on daily basis makes the awareness of any least changes hits women directly on their faces without having to be told. However the evidence presented by this study thus far suggests that majority of males are aware of climate change than females.

The differentiated climatic variability awareness among the sexes can vividly be ascertained by the statements below from the field:

I understand and experience climate change directly when I see my backyard garden totally dried up. When I cannot get any vegetable from my backyard for food or simple local herbs for treating simple ailments for a dying child, there, I do not need any one to tell me about climate change because I feel and smell it all around me. (A female farmer and a Women's leader from KAPND).

Similar observations on the awareness level of some male farmers are shown below:

Rains no longer come the time it is expected, but can come early or late, without a consistent pattern. So farmers who still want to rely on the old raining pattern become very disappointed. Now, farmers are afraid to sow corn, for instance, with the first rains, because the rains could stop at the tasselling stage when it is most needed" (A male farmer from Amankwaa, KAPND)

The statement from this male farmer indicates that some farmers have noticed some changes in the weather pattern and thus aware of the changes in climatic conditions over the years. Although these are lived experiences or could be largely influenced by information, one could underscore the fact that more farmers are aware of climate change and variability. For instance, one male respondent interviewed also indicated that:

What farmers knew before was that the last rains came in November through to December, and the first normally started in late February, intensifying seriously in April, and ending between May and July. With this, the Dayi River usually overflows its banks. Unfortunately, there has not been any rain from November last year (2015) till March this year 2016. It was only at the end of March that we experienced two (2) small periods of rain. Even this April, 2016, communities are still experiencing small pockets of rainfall unlike the olden days. There is a bit of heavy rain in May now, which cannot even be predicted and the August drought is now longer. (A male leader and a farmer from Kpando Central, KpMU)

The study further sought the need to estimate how certain socio-demographic variables can predict climate change and variability awareness in both KAPND and KpMu. This was to ascertain how sex, age group, highest level of education attained and geographic location can predict climate change and variability awareness. Thus, a binary logistic regression was performed. Also, the variable ‘years of farming’ was included because most farmers depend on these climatic conditions for farming. Thus, one can unequivocally point out that, it would be ideal to note changes in climatic conditions based on years of farming and so the experience gained in farming can have an influence on ones’ perception. The results are presented in Table 4.4.

Table 4.4: Binary Logistic Regression Coefficients estimating the effects of predictors such as study site, sex, age, level of education and years offarming on climate change/variability awareness

Predictors	B	S.E.	Wald	Odd Ratio	95% C.I. for EXP(B)	
					Lower	Upper
Study Site						
KAPND	-.013	.261	.003	.987	.592	1.645
KpMu (reference category)				1.000		
Sex						
Male	3.310	.440**	56.471	27.374	11.547	64.897
Female(reference category)				1.000		
Age group						
Less than 21 years	.124	1.324	.009	1.132	.084	15.163
21-30 years	1.172	.547*	4.589	3.227	1.105	9.427
31-40 years	1.209	.476*	6.450	3.352	1.318	8.524
41-50 years	.406	.459	.786	1.501	.611	3.688
51-60 years	.797	.489	2.651	2.218	.850	5.789
Above 60 years(reference category)				1.000		
Level of Education						
No Education	-.912	1.143	.636	.402	.043	3.773
Non formal	-.419	1.166	.129	.658	.067	6.460
Basic	-.596	1.131	.278	.551	.060	5.060
Secondary	-.937	1.165	.647	.392	.040	3.840
Tertiary(reference category)				1.000		
Years of farming						
Less than 1 year	-.850	1.423	.357	.427	.026	6.955
1-3 years	-.623	.561	1.234	.536	.179	1.610
4-6 years	-.711	.389	3.339	.491	.229	1.053
7-9 years	-.323	.401	.647	.724	.330	1.590
More than 9 years (reference category)				1.000		

Note: Note: R² =0.54 (Nagelkerke); Cox & Snell)= .200;(Hosmer & Lemeshow) Goodness-of-Fit χ^2 (8)= 25.837; -2 Log Likelihood = 414.387; *p<.05, **p<.01, Climate change/variability awareness is the dependent variable.

Source: Fieldwork, 2016

The residual chi square test of 25.87 ($p < 0.05$) depicts the robustness of the model at 95 percent confidence level. The Nagelkerke R^2 value of 0.54 suggests that the model correctly predicts 54 percent of variance in climate change and variability awareness among farmers in the selected study areas while the Hosmer and Lemeshow test which is not significant at 5% level of significance shows that these sets of selected predictor variables better predict climate change/variability awareness in the study areas.

In addition, the Omnibus tests of model coefficient computed rejects the null hypothesis that suggests that the model is not a significant fit of the data ($\chi^2 = 25.837$, $p < 0.05$). Also, the overall predictive accuracy of the model is 83.7 percent. In terms of the predictor variables selected, study site or area ($p > 0.05$), level of education ($p > 0.05$), and years of farming ($p > 0.05$), did not significantly predict the outcome variable (*Climate change/variability awareness*) of the model. Conversely, sex ($p < 0.05$), and age ($p < 0.05$) significantly predicted the outcome of the model (see Table 4.4). The results of the analysis indicate that the likelihood of being aware of climate change and variability increases with being a male than female. Thus, males (OR=27.37, CI=11.55-64.90) are 27 times more likely to be aware of climate change/variability than females in the study area (see Table 4.4). It was confirmed from the findings that many male farmers could talk extensively about climate change, even the definition and about what is happening in other countries or elsewhere because majority could read and have the ability and time to seek more knowledge from the environment on their own generally than women farmers. In terms of age, those within the ages of 21-30 years (OR=3.23, CI=1.11-9.43) and 31-40 years (OR=3.35, CI=1.38-8.52) were 3 times more likely to be aware of climate change/variability than those above 60 years. One would have expected people aged (those above 40 years) to be more aware of such changes in climatic conditions over the years given their age and experience with such weather and climate phenomena.

However, those within the ages of 21-30 years and 31-40 years were more likely to be aware of such changes. This could be as a result of access to information and use of technology. Majority of those within the ages of 21-30 years and 31-40 years may be “digital natives” and thus have ready access to technology and could be more privy to information on climate related events via the internet, radio, or television.

Against the backdrop that majority of respondents (83.2%) were aware of climate change and variability; the study sought the need to examine the sources of information pertaining to climate change and variability from respondents. This was examined in relation to sex of respondents in both KAPND and KpMu. The results of the analysis are presented in Table 4.5. Out of the 504 respondents who were aware of climate change and variability in both districts, 61.8 percent stated that they get their information from the radio, followed by 37.7 percent who get their information from friends and 25.4 percent who depend on neighbours for information on climate change and variability. Moreover, majority of both males and females depend on radio and friends as their sources of information. The results show that television is the least dependent source of information in relation to climate change and variability. One would have expected television to be the major source of information on climate change and variability because weather and climate issues are mostly communicated via television in Ghana.

However, it can rightly be pointed out that, radio serves as the major information source relative to television because that could be the most accessible and cheap source of information in such rural communities. It was found that, even some mobile phones and touch lights could easily be switched to radio stations with no difficulty. As such, whether in the farm, on the road to farm, at home or within the community, both male and female, farmers could be listening to the radio stations of their choice and they informally learn a lot about the weather and its variability daily. Most of these farmers do not own television

sets and thus cannot depend on it for information and even the few who owned one could only watch after close of days' activities. In addition, social bonds and social capital in such rural communities are mostly strong and hence people mostly depend on friends for information. It is thus not surprising that a lot of people depend on friends and neighbours than television for climate change and variability information (see Table 4.5).

Table 4.5: Relationship between sources of information pertaining to climate change/variability and sex (multiple responses)

Study site	Sex	Radio n=312 (61.8%)	Television n=117 (23.2%)	Friends n=190 (37.7%)	Neighbours n=128 (25.4%)
KAPND	Male (n=143)	107 (74.8%)	43 (30.1%)	66 (46.2%)	55 (38.5%)
	Female (n=106)	79 (74.5%)	24 (22.6%)	38 (35.8%)	28 (26.4%)
	Total (n=249)	186 (74.7%)	67 (26.9%)	104 (41.8%)	83 (33.3%)
KpMu	Male (n=157)	79 (50.3%)	33 (21.0%)	53 (33.8%)	26 (16.6%)
	Female (n= 98)	47 (48.0%)	17 (17.3%)	33 (33.7%)	19 (19.4%)
	Total (n=255)	126 (49.4%)	50 (19.6%)	86 (33.7%)	45 (17.6%)
Both (KAPND & KpMu)	Male (n=300)	186 (62.0%)	76 (25.3%)	119 (39.7%)	81 (27.0%)
	Female (n=204)	126 (61.8%)	41 (20.1%)	71 (34.8%)	47 (23.0%)

Source: Fieldwork (2016)

4.4 GENDERED PERCEPTIONS ABOUT CHANGES IN CLIMATIC CONDITIONS

Further attempts were made to examine farmers' perceptions on climate change and variability in the two districts. This was assessed in relation to perceived significant changes in climatic condition such as rainfall and temperature; that is, if they have

increased, decreased or remained the same. In view of this, cross tabulations and chi square test of association were computed to assess the relationship between sex and perceived significant changes in climatic conditions. The results of the analysis are presented in Table 4.6.

Table 4.6: Relationship between perceived significant changes in climatic conditions and sex

Study sites	Sex	Perceived Significant Changes in Climatic Conditions			Total
		Same	Increased	Declined	
KAPND	Male	17 (11.4%)	104 (69.8%)	28 (18.8%)	149 (100.0%)
	Female	37 (24.8%)	99 (66.4%)	13 (8.7%)	149 (100.0%)
	Sb-total	54 (18.1%)	203 (68.1%)	41 (13.8%)	298 (100.0%)
$\chi^2=13.02$, df (2), p value= 0.0001<0.05					
KpMu	Male	6 (3.8%)	125 (79.6%)	26 (16.6%)	157 (100.0%)
	Female	18 (11.9%)	47 (31.1%)	86 (57.0%)	151 (100.0%)
	Sub-total	24 (7.8%)	172 (55.8%)	112 (36.4%)	308 (100.0%)
$\chi^2=73.43$, df (2), p value= 0.0001<0.05					
Both (KAPND & KpMu)	Male	23 (7.5%)	229 (74.8%)	54 (17.6%)	306 (100.0%)
	Female	55 (18.3%)	146 (48.7%)	99 (33.0%)	300 (100.0%)
	Total	78 (12.9%)	375 (61.9%)	153 (25.2%)	606 (100.0%)
$\chi^2=44.68$, df (2), p value= 0.0001<0.05					

Source: Fieldwork (2016)

Out of the 606 respondents sampled, 61.9 percent revealed that there has been increase in climatic conditions, 25.2 percent perceived a decline in climatic conditions and 12.9 percent were of the view that there has been no significant changes. This suggests that majority of respondents perceive an increase in climatic conditions over the years. In

terms of relationship between gender and perceived significant climatic changes, the chi square test shows a significant relationship between the two variables ($p < 0.01$). This is because a greater percentage of males (74.8%) than females (48.7%) were of the view that there has been an increase in climatic conditions whereas more females perceive a decline or no significant changes in climatic conditions as compared to males (see Table 4.6). It also emerged from the results that there is a significant relationship between gender and perception about changes in climatic conditions in KpMu ($p < 0.01$), as majority of males (79.6%) in KpMu perceive an increase in climatic conditions whereas majority of females (57%) perceive a decrease in amount of rainfall. It indicates that, though they all perceive changes in the climatic conditions, each sex sees and understand it differently based on their socialisation and needs. The case of KAPND is no exception considering the fact that gender significantly relates with perceived changes in climatic conditions ($p < 0.01$). A husband and wife, both farmers from KAPND expressed their views as below:

Though I am an illiterate and cannot read and write like my husband, I understand climate change practically from lack of basic needs like water and firewood. I think it doesn't rain like it use to and so I have to travel long distances for water and firewood to feed the family. These roles are my responsibility as a woman and must be provided at all cost, so my prayer is for a favourable weather/climate always (A female farmer, a wife & a Queen of a village in KAPND).

The husband expressed his view as follows:

I see climate change as a monstrous animal in this society. It is destroying all our forest, land and river bodies. My palm and plantain plantations as well as even my corn farm are not yielding even half of what I could harvest from same field ten years ago because of increase in temperature and heat that comes with it. It has left me impoverished at my age (a male farmer and a husband).

The views expressed by the couple highlights the fact that temperature and rainfall are the major climatic elements these couple could relate to in terms of explaining variations in climatic conditions.

Aside assessing respondents' perceptions regarding changes in climatic conditions, it is relevant to examine significant climatic changes experienced or observed by respondents over the years. Again this was examined in relation to sex of respondents in order to examine gender variations in responses. The responses given are presented in Table 4.7. Out of the 528 respondents that perceived an increase or decrease in climatic conditions, about 48 percent indicated that they have experienced changes in the duration of the raining season in both districts while 25 percent and 20 percent respondents attributed high temperature and low or inadequate rainfall as experienced changes in climate respectively. Only 7 percent of respondents indicated sporadic or intense rainfall as a major significant change in climate experienced. These significant climatic changes experienced by farmers are reflected in the following statements:

The heat is too much and the temperature keeps rising every day. If human beings are burning from this heat, what else can one expect for our crops? Crop failure is then unavoidable. And whether, there is food or not a woman will have to feed the family (A female farmer, KAPND).

Over the years, the rain pattern has changed drastically. It comes when it is least expected and at times sporadic. We cannot plan with it as farmers. We cannot pay our loans because of poor rains leading to poor yield. (A male farmer, Assemblyman, KpMu)

Indeed, in terms of gender variations in the general responses and as evident in the above statements, majority of males (62.2%) attributed changes in the duration of raining season as a major significant change in climate observed whereas a higher percentage of females (43.3%) indicated high temperature as an observed change in climatic conditions. In view of this, the chi square test showed a significant relationship between gender and observed/experienced changes in climatic conditions ($p < 0.01$). In KAPND for example,

sex of respondents significantly relates to reported observed climatic changes ($p < 0.01$), as majority of males (75%) indicated changes in duration of raining season as experienced changes in climate but majority of females (62.5%) attributed high temperature as an observed or experienced change in climate in KAPND

Table 4.7: Relationship between experienced/observed significant climatic conditions and sex in KAPND & KpMu

Study site	Sex	Experienced/Observed significant Climatic Changes				Total
		Low/ Inadequate rainfall	Changes in The Duration of the Raining Season	High Temperature	Unexpected/ Sporadic and Intense Rainfall	
KAPND	Male	11 (8.3%)	99 (75.0%)	19 (14.4%)	3 (2.3%)	132 (100.0%)
	Female	5 (4.5%)	36 (32.1%)	70 (62.5%)	1 (0.9%)	112 (100.0%)
	total	16 (6.6%)	135 (55.3%)	89 (36.5%)	4 (1.6%)	244 (100.0%)
$\chi^2=60.643, df (3), p \text{ value} = 0.0001 < 0.05$						
KpMu	Male	51 (33.8%)	77 (51.0%)	7 (4.6%)	16 (10.6%)	151 (100.0%)
	Female	40 (30.1%)	40 (30.1%)	36 (27.1%)	17 (12.8%)	133 (100.0%)
	total	91 (32.0%)	117 (41.2%)	43 (15.1%)	33 (11.6%)	284 (100.0%)
$\chi^2=31.61, df (3), p \text{ value} = 0.0001 < 0.05$						
Both (KAPND & KpMu)	Male	62 (21.9%)	176 (62.2%)	26 (9.2%)	19 (6.7%)	283 (100.0%)
	Female	45 (18.4%)	76 (31.0%)	106 (43.3%)	18 (7.3%)	245 (100.0%)
	Total	107 (20.3%)	252 (47.7%)	132 (25.0%)	37 (7.0%)	528 (100.0%)
$\chi^2=88.62, df (3), p \text{ value} = 0.0001 < 0.05$						

Source: Fieldwork (2016)

Additionally, the study sought to examine observed environmental changes in the study sites. The responses given were examined in relation to the sex of respondents. The results are presented in Table 4.8. Respondents identified several observed environmental

changes such as erratic rainfall, persistent drought, flood, bush fire and increased pest and diseases.

Table 4.8: Relationship between observed environmental changes and sex (multiple responses)

Study Site	Sex	Observed Environmental Changes					
		Erratic rainfall	Persistent drought	Flood	Bush Fire	Increased pest & disease	Others
KAPND	Male	120 (80.5%)	99 (66.4%)	45 (30.2%)	90 (60.4%)	68 (45.6%)	12 (8.1%)
	Female	123 (82.6%)	108 (72.5%)	41 (27.5%)	84 (56.4%)	56 (37.6%)	12 (8.1%)
	total	243 (81.5%)	207 (69.5%)	86 (28.9%)	174 (58.4%)	124 (41.6%)	24 (8.1%)
KpMu	Male	74 (47.1%)	12 (7.6%)	71 (45.2%)	32 (20.4%)	91 (58.0%)	127 (80.9%)
	Female	53 (35.1%)	10 (6.6%)	54 (35.8%)	14 (9.3%)	79 (52.3%)	111 (73.5%)
	total	127 (41.2%)	22 (7.1%)	125 (40.6%)	46 (14.9%)	170 (55.2%)	238 (77.3%)
Both (KAPND & KpMu)	Male	194 (63.4%)	111 (36.3%)	116 (37.9%)	122 (39.9%)	159 (52.0%)	139 (45.4%)
	Female	176 (58.7%)	118 (39.3%)	95 (31.7%)	98 (32.7%)	135 (45.0%)	123 (41.0%)
	Total	370 (61.1%)	229 (37.8%)	211 (34.8%)	220 (36.3%)	294 (48.5%)	262 (43.2%)

Source: Fieldwork (2016)

Majority of respondents (61.1%) identified erratic rainfall as an environmental change, followed by increased pest and disease (48.5%) and persistent drought (37.8%). Also, 34.8 percent and 36.3 percent of respondents identified flood and bushfire as some observed changes in the environment respectively. A higher percentage of males (63.4%) than females (58.7%) perceive erratic rainfall as an environmental change whiles more females than males identified persistent drought as an environmental change (see Table 4.8). Aside the majority of respondents in KAPND that indicated erratic rainfall as an observed environmental change, a higher percentage of respondents identified persistent

drought as an environmental change while 28.9 percent also indicated flood as an observed change in environment. On the other hand, majority (55.2%) of respondents in KpMu identified increased pest and disease as an observed environmental change, whereas majority of respondents in KAPND reported erratic rainfall as an observed environmental change.

The sentiment of some farmers were expressed during FGDs as follows:

Now, the unexpected change in the rainfall pattern has seriously altered the growing time. We are never sure whether early planting with the first rain will be reliable or not. Last year the rains failed when my corn was at the tasselling stage, so my crops failed miserably. As I sit, I don't know what is in store for us this year (A male farmer, KpMu).

There is serious pest and disease infestation due to the bad weather conditions making the few vegetables produced unattractive for sale. It is making it difficult to make ends meet (A female farmer, KAPND).

Towards a thorough assessment of respondents' perceptions about the causes of changes in climatic conditions, an attempt was made to examine perceived causes of changes in climatic variables. In view of this, respondents were asked to indicate their perceptions about the causes of changes in climatic conditions such as rainfall and temperature. Again this was examined in relation to sex of respondents. The results are presented in Table 4.9. Out of the 528 respondents that perceived an increase or decrease in climatic conditions, majority (54.4%) suggested deforestation as the major cause of changes in climate. Another 37.1 percent of respondents blamed damages to water bodies as the major cause while 8.3 percent reported damage to the ozone layer as the main cause of changes in climate. Less than one percent of respondents were of the view that changes in climatic conditions are due to natural factors. In addition, majority of both males (53.4%) and females (55.5%) perceived deforestation as the major cause of changes in climate. With regards to the various study sites, whereas nearly 85 percent of respondents in KAPND suggested deforestation as the major cause of changes in climatic condition,

about only 28% showed this view in KpMu. Majority of respondents from KpMu (63.4%) perceived damages to water bodies as the major cause of climate change and variability in their respective districts. Only one male respondent from KAPND attributed natural occurrences as the major cause of changes in climate. From the responses, it is evident that majority of the farmers in the two districts, both males and females associated climatic change to anthropogenic influences that must be controlled as reflected in this assertion by a farmer:

Indiscriminate tree cutting is destroying our forest leading to degradation of our lands. Farming too close to the river bodies is also contributing to the diminishing of our rivers bodies. How can rains come, when all trees are gone? Now, here we are suffering from excessive heat and poor harvest (A male farmer, KpMu).

Table 4.9: Relationship between perceived causes of changes in climatic conditions and sex

Study site	Sex	Perceived Reasons for Changes in Climatic Variables				Total
		Deforestation	Damages to water Bodies	Damages to the Ozone Layer	Natural Occurrences	
KAPND	Male	110 (83.3%)	9 (6.8%)	12 (9.1%)	1 (0.8%)	132 (100.0%)
	Female	97 (86.6%)	7 (6.3%)	8 (7.1%)	0 (0.0%)	112 (100.0%)
	Total	207 (84.8%)	16 (6.6%)	20 (8.2%)	1 (0.4%)	244 (100.0%)
KpMu	Male	41 (27.2%)	97 (64.2%)	13 (8.6%)	0 (0.0%)	151 (100.0%)
	Female	39 (29.3%)	83 (62.4%)	11 (8.3%)	0 (0.0%)	133 (100.0%)
	Total	80 (28.2%)	180 (63.4%)	24 (8.5%)	0 (0.0%)	284 (100.0%)
Both (KAPND & KpMu)	Male	151 (53.4%)	106 (37.5%)	25 (8.8%)	1 (0.4%)	283 (100.0%)
	Female	136 (55.5%)	90 (36.7%)	19 (7.8%)	0 (0.0%)	245 (100.0%)
	Total	287 (54.4%)	196 (37.1%)	44 (8.3%)	1 (0.2%)	528 (100.0%)

Source: Fieldwork (2016)

4.5 SUMMARY

This chapter examined the background characteristics of respondents sampled and their perception and awareness of climate change and variability in KAPND and KpMu. Comparatively, there were more males than females and a higher percentage of respondents sampled were within the ages of 31-40 years and 41-50 years. Also, majority of respondents were married (70.3%) compared to those who were single (17.8%), divorced (5.6%) and widowed (4.0%). In terms of religious affiliations, majority of respondents were Christians (89.4%) compared to 5.4 percent that were Muslims. With regards to the level of education of respondents, 44.9 percent had attained basic level of education, 19 percent had achieved secondary education, and 4.5 percent had received some form of tertiary education. On the other hand, 12.7 percent had not received any formal education.

Majority of respondents (83.2%) were aware of climate change and variability. More males (98.0) than females (68.0%) were aware of climate change and variability. In estimating the effect of predictors such as study site, sex, age, level of education and years of farming on climate change and variability awareness, the results indicate that study site ($p>0.05$), level of education ($p>0.05$), and years of farming ($p>0.05$), did not significantly predict the outcome variable (climate change and variability) whereas sex and age significantly predicted the outcome of the model. The likelihood of being aware of climate change and variability increases with being a male than female. Thus, males (OR=27.37, CI=11.55-64.90) were 27 times more likely to be aware of climate change/variability than females in the study area whereas respondents within the ages of 21-30 years (OR=3.23, CI=1.11-9.43) and 31-40 years (OR=3.35, CI=1.38-8.52) were 3 times more likely to be aware of climate change/variability than those above 60 years. Radio, friends and neighbours were reported as the major sources of information on issues pertaining to climate change and variability than television.

In addition, majority of respondents perceive an increase in climatic conditions over the years. In terms of relationship between sex and perceived significant climatic changes, the chi square test shows a significant relationship between the two variables ($p < 0.01$). This is because a greater percentage of males (74.8%) than females (48.7%) were of the view that, there has been an increase in climatic conditions whereas more females perceive a decline or no significant changes in climatic conditions as compared to males. Deforestation and damages to water bodies and the ozone layer were reported as perceived causes of changes in climatic conditions.

CHAPTER FIVE

EFFECTS OF CLIMATE CHANGE AND VARIABILITY ON LIVELIHOOD ACTIVITIES OF SMALLHOLDER FARMERS

5.1 INTRODUCTION

This chapter presents the analyses and discussions on the effects of climate change and variability on livelihood activities of male and female smallholder farmers in KAPND and KpMu. The effects of climate change and variability in this context were examined in three forms, that is, physical, socio-economic and psychological. The first section presents a detailed analysis of the physical effects of climate change and variability in relation to the sex of farmers selected in both districts. The second section also provides an in-depth analysis of the socio-economic effects of changes in climatic conditions in KAPND and KpMu. Again, this was done in relation to sex of these farmers sampled. Lastly, the psychological effects of climate change and variability effects on the farmers sampled are further discussed in this chapter.

5.2 PHYSICAL EFFECTS OF CLIMATE CHANGE AND VARIABILITY ON FARMING ACTIVITIES IN KAPND AND KPANDO MUNICIPALITY

The effects of climate change and variability on agricultural production system, food production and the development of agriculture in Africa have been acknowledged by several studies (FAO, 2010; Stoker, 2014; IPCC, 2014). Agostino (2010) notes that the brunt of these effects is grossly felt by people in most developing countries. The study further reports that the vulnerability of these people is based on different factors such as age, gender, and location (geography), ethnicity and income. This suggests that the effect of changes in climatic conditions can be related to gender.

In view of the fact that climate change and variability affects men and women differently (Dankleman, 2010), the study sought the need to examine the physical effects of climate change and variability on farming activities in KAPND and KpMu. This was examined in relation to the sex of respondents. Cross tabulations and chi square test of association were computed to assess the relationship between the two variables. The results of the analysis are presented in Table 5.1. Out of the 606 respondents sampled, 51 percent indicated that climate change and variability result in reduction in crop productivity. Also, 44.6 percent stated that changes in climatic conditions such as rainfall and temperature result in the outbreak of diseases on their farm, thereby infesting their crops. Only 4.4 percent of respondents attributed increase in temperature or heat stress as the major physical effect of climate change and variability of farming activities in KAPND and KpMu.

With regards to the sex of respondents, more males (55.2%) indicated reduction in crop productivity as the major physical effect of climate change and variability. On the other hand, more female respondents (50.0%) stated disease infestation as the major physical effect compared to the other effects. The chi square test showed a significant relationship between sex and reported physical effects of climate change and variability on farming activities in KAPND ($p < 0.05$), KpMu ($p < 0.05$) and the total sample ($P < 0.05$). In KAPND for instance, a higher percentage of males (71.8%) compared to females (58.4%) indicated reduction in the productivity of crops as the major physical climate change and variability effect whiles more females (34.9%) than males (20.8%) were of the view that disease outbreak and infestation are the major physical effect of climate change. It was observed that the high temperatures coupled with high humidity create conducive atmosphere for bacteria and insect/pest breeding in the two districts, especially in

KAPND where cattle raiding is rampant and presents a threat to crop farming (Rojas-Downing et al., 2017).

Table 5.1: Relationship between physical effects of climate change and variability and sex

		Physical Effects of climate change and variability on Farming Activities			
Study Site	Sex	Reduction in Crop Productivity	Disease outbreak & infestation	Increase in Temperature/ Heat stress	Total
KAPND	Male	107 (71.8%)	31 (20.8%)	11 (7.4%)	149 (100.0%)
	Female	87 (58.4%)	52 (34.9%)	10 (6.7%)	149 (100.0%)
	total	194 (65.1%)	83 (27.9%)	21 (7.0%)	298 (100.0%)
$\chi^2=7.423$, df (2), p value= 0.024<0.05					
KpMu	Male	62 (39.5%)	89 (56.7%)	6 (3.8%)	157 (100.0%)
	Female	53 (35.1%)	98 (64.9%)	0 (0.0%)	151 (100.0%)
	total	115 (37.3%)	187 (60.7%)	6 (1.9%)	308 (100.0%)
$\chi^2=7.023$, df (2), p value= 0.030<0.05					
Total (KAPND & KpMu)	Male	169 (55.2%)	120 (39.2%)	17 (5.6%)	306 (100.0%)
	Female	140 (46.7%)	150 (50.0%)	10 (3.3%)	300 (100.0%)
	Total	309 (51.0%)	270 (44.6%)	27 (4.4%)	606 (100.0%)
$\chi^2=7.811$, df (2), p value= 0.020<0.05					

Source: Fieldwork (2016)

In contrast, the evidence from Table 5.1 shows that, whereas majority (65.1%) of respondents from KAPND suggested reduction in the productivity of crops as the major climate change and variability effect, majority of respondents from KpMu (60.7%) reported disease outbreak and infestation as the major physical effect of climate change and variability on farming activities in the district. The effects were explained by two farmers as follows:

There is poor harvest because of poor rains and serious pest infestation beyond our control. Most fruit trees now bear small fruits with more insects and stem borer infestations. Some of the insects are beetles, grasshoppers and stem borers (eabor) that could chop plants to death. For instance, when okro starts bearing flowers or corn starts tasselling, they fall when there is less rain coupled with insect attack. Farmers fear that some of the infestations could come from the cattle droppings all over the fields without control, some of which are too watery (A female farmer, KAPND).

Years back, a plot of oil palm plantain that could yield about 20 bags, now can yield less than 5 bags. Thus, it is hard to make ends meet for a lot of farmers now (A male Farmer, KpMu).

Indeed, in the work of Mbilinyi et al (2013) with farmers in Korogwe community in Tanzania, they also indicated that small-scale farming in Africa including Ghana is worst affected by climate change because most of the farmers rely solely on rain-fed agriculture and the least changes creates serious destruction to farmers produce.

Furthermore, the emergence of very wild grass that needed chemicals such as weedicides to control was a concern of farmers. Earlier on some weeds like ‘Acheampong’ hitherto was manageable to farmers but due to prolonged harmattan (dry season) and bush fires, most of the old known weeds are extinct and given way to wild grasses, which was also affecting the types of crops grown. For instance, in the past, tress crops (like palm trees, oranges) and food crops such as plantain did very well but has been replaced by new crops such as maize, yam, tiger nuts and vegetables (e.g. onions), most of which were traditionally known as women’s crops. The finding is in agreement with Giddens’ conviction that patterns of human organisation are changeable by human agency (Giddens, 1984; Holt-Jensen, 2009). Indicating that human behaviour and social norms are dynamic depending on the circumstances, so farmers’ could change their behaviour/practices in coping to climatic changes, and when it continues for a long time then that could become an established adaptation strategy for their survival.

It also came out from the FGDs that the effect of changing climate is so severe that most non-timber forest products like snails and mushroom were disappearing. These invariably have consequences for agricultural production and food security especially at the household level. A women's group leader and a farmer reflected on the good old days when some non-timber forest products that were picked freely from farms and the environs supported household food security and incomes. She indicated passionately as follows:

“Few years ago farmers rose up early to farm during the raining seasons to chance on wind falls of mushrooms covering small hills, with others on edible rotten tree logs and palm trees. In addition, snails of various sizes could also be picked with no or a little search for free. These non-timber forest products served as a major source of protein first for the household and the remaining sold for extra income for the family. Unfortunately, all these have disappeared today (Summary View from Women's FGD, KAPND).

The sentiments expressed by these women farmers throw light on the fact that the physical effects of climate change are hitting farmers hard on their livelihoods activities, incomes and even their health status.

5.3 SOCIO-ECONOMIC EFFECTS OF CLIMATE CHANGE AND VARIABILITY ON SMALLHOLDER FARMERS

Climate change and variability has far reaching consequences on the socio-economic lives of people, especially the most vulnerable and poor (UNDP, 2007; 2009; Agostino, 2010). In the midst of discrimination, gender roles and poverty, the impact of climate change and variability tend to exacerbate the burden of most women. It is against this backdrop that this study sought the need to examine the relationship between gender and socio-economic effects of climate change and variability on farmers. Again, cross tabulations and chi square test were computed to examine this relationship. The study allowed for multiple responses from respondents. The results of this analysis are

presented in Table 5.2. Respondents identified several socio-economic effects including waste of resources, increased hunger and weakness, food debts, increased family conflict and out-migration. Others including poor sanitation and lack of access to water, loss of productive time, and loss of status and inability to provide and improve the well-being of the family as some socio-economic effects of climate change and variability effects in KAPND and KpMu.

The results presented in Table 5.2 shows that majority of respondents indicated loss of family status and inability to provide for family's wellbeing as the major socio-economic effect, followed by waste of resources (51%), and 50.2 percent of respondents bemoaned poor sanitation as a socio-economic effect of climate change and variability in the two district. In addition, 49 percent and 40.9 percent of respondents indicated increased family conflict and out-migration respectively as some socio-economic effect of changes in climatic conditions in the two districts. Food debts and waste of resources accounted for 23.2 percent and 28.2 percent of responses from respondents respectively. Given the fact that, males are mostly the breadwinners of households and thus obligated to provide for the family, it was not surprising when the chi square test showed a significant relationship between gender and socio-economic effect of climate change and variability in terms of loss of family status and inability to provide for the families well-being in KAPND ($p < 0.01$), KpMu ($p < 0.01$) and collectively ($p < 0.01$). This is because majority of males (82.7%) than females (26%) perceive loss of status in the family as a major socio-economic effect. The concerns of a male farmer were expressed as below:

It is men who are supposed to take care of their children and family members. We are the bread winners and need more money to serve this duty well. To most of us, women just play a supporting role, hence to leave our responsibility totally for a woman means we are as well trading our authority. Nowadays, it is becoming difficult for wives and children to give the needed respect and recognition to us because most men are not able to provide the family's basic needs (A male farmer, Amankwaa, KAPND).

Table 5.2: Relationship between socio-economic effects of climate change and variability and gender

Study site	Socio-economic Effects								
	Sex	Waste of resources	Increased hunger & weakness	Food debts	Increased family conflict	Out-migration	Poor sanitation and access to water	Waste of Productive time	Loss of status and inability to improve the well-being of the family
KAPND	Male (n=149)	43.0%	58.4%	44.6%	69.1%	79.9%	22.8%	39.6%	76.5%
	Female (n=149)	43.6%	42.3%	41.9%	30.2%	9.4%	83.9%	77.2%	18.8%
	Total (n=298)	43.3%	50.3%	43.2%	49.7%	44.6%	53.4%	58.4%	47.7%
χ^2 (at 5% significance)	level of	$\chi^2=.14$, p=0.91	$\chi^2=7.73$, p=0.01	$\chi^2=0.22$, p=0.64	$\chi^2=45.2$, p=0.001	$\chi^2=149.7$, p=0.0001	$\chi^2=111.66$, p=0.0001	$\chi^2=43.3$, p=0.001	$\chi^2=99.5$, p=0.001
KpMu	Male (n=157)	14.6%	37.6%	1.3%	64.3%	65.6%	21.7%	31.2%	88.5%
	Female (n=151)	12.6%	11.3%	6.6%	31.8%	7.9%	73.5%	57.0%	33.1%
	Total (n=308)	13.6%	24.7%	3.9%	48.4%	37.3%	47.1%	43.8%	61.4%
χ^2 (at 5% significance)	level of	$\chi^2=.028$, p=0.87	$\chi^2=28.84$, p=0.001	$\chi^2=6.14$, p=0.04	$\chi^2=32.7$, p=0.001	$\chi^2=109.4$, p=0.0001	$\chi^2=83.1$, p=0.001	$\chi^2=21.2$, p=0.001	$\chi^2=99.7$, p=0.001
Both (KAPND & KpMu)	Male (n=306)	28.4%	47.7%	22.3%	66.7%	72.5%	22.2%	35.3%	82.7%
	Female (n=300)	28.0%	26.7%	24.1%	31.0%	8.7%	78.7%	67.0%	26.0%
	Total (n=606)	28.2%	37.3%	23.2%	49.0%	40.9%	50.2%	51.0%	54.6%
χ^2 (at 5% significance)	level of	$\chi^2=.14$, p=0.99	$\chi^2=28.84$, p=0.001	$\chi^2=0.46$, p=0.79	$\chi^2=77$, p=0.0001	$\chi^2=255.94$, p=0.0001	$\chi^2=193.1$, p=0.001	$\chi^2=61.4$, p=0.001	$\chi^2=196.34$, p=0.001

Source: Fieldwork (2016)

In worsening their plight, during an FGD at KAPND, male farmers mentioned that members who went for loans but were not able to repay as scheduled because of crop failure, went through serious humiliations openly from debtors even in front of their children and family members. And most of them linked it to loss of respect and status in the home and community.

More often than not, women are noted to take on the increased burden of care, especially domestic or household care. Most women need enough productive time to enable them take care of the household and also engage in farming. In addition, women and children are over-burdened with ensuring proper sanitary conditions and water in the household. For instance, some anecdotal evidence suggests that in case of water stress, most women spend productive time looking for water for the entire household. Undeniably, there is growing evidence in literature that socio-economic effects of the changing climatic conditions is associated with changes in gender roles where women farmers tend to spend more hours attending to family and house chores including searching for water during drought at the expense of other economic activities (Mbilinyi et al., 2013, Wrigley-Asante et al., 2017). One woman who participated in a female FGD in Kpando Municipality reiterated:

Our workload has increased as women in searching for water and firewood during hazardous climatic periods, and we have to combine this with farming and other traditional house chores. More importantly, poor crop yields negatively affects food supply quantities for household members. The man provides the pocket money and they often thinks of large scale projects/ activities (A female farmer, Kpando Municipality).

It was not surprising that the chi square test showed a significant relationship between gender and loss of productive time, poor sanitation and lack of access to water as socio-economic effects of climate change and variability (see Table 5.2). In this vein, the literature has highlighted that, the high vulnerability of women in climate change effects

linked to gender division of labour and limited access to productive resources should be a concern (Whitehead & Tsikata, 2003; Teye, Yaro & Bawakyillenuo, 2015).

Migration is noted as a key behavioural response to climate change and variability effect, especially in times of postharvest losses, debt and conflict even though it is noted as a key adaptive strategy for males (Egyir et al., 2014). These push factors are mostly as a result of changes in climatic conditions. To reduce vulnerability, migration is increasingly noted as a significant response to environmental change (Gleditsch et al., 2007; Morrissey, 2009). Against this background, 72.5 percent of males as compared to females (8.7%) were of the view that out-migration is a major socio-economic effect of climate change and variability in KAPND and KpMu. This is because, traditionally, men are mostly breadwinners of households and thus the onus to provide for the family lies on them. Men's migration could create challenges for the left-behind, especially females, in the sense that women have to support their households all alone in the absence of their husbands. One is careful not to establish causality in this regard but it would suffice to point out that these are responses from male respondents and thus, a bit reflective of either experienced, observed or perceived event. In view of this, the chi square test showed a significant relationship between the two variables in KAPND ($p < 0.01$), KpMu ($p < 0.01$) and both KAPND and KpMu ($p < 0.01$). In buttressing out-migration as a response to climatic crisis a 'young male farmers' group' during FGDs saw it as a safety net in battling such eventualities and reiterated:

To avoid shame and humiliation from family members, because of our inability to provide their basic needs, mostly young male farmers decide to migrate to the nearby cities to look for temporary jobs to save the situation (A male farmer, KpMu).

Also majority of males (66.7%) indicated increased family conflict as a major socio-economic effect of changes in climatic conditions as compared to females (31.0%). In

view of this, the test showed a significant relationship between sex and family conflict as a socio-economic effect in both districts (see Table 5.2). It was found that, the conflicts often occur when men are not able to perform their traditionally known roles of paying children's school fees, providing pocket money, shelter et cetera. and the wives see it as shirking their responsibilities on them because as women, they would have to do whatever it takes to feed the family at least one hot meal a day. As such, any additional responsibility over burdens and stresses them. Certainly, Egyir et al. (2014) and Wrigley-Asante et al. (2017) have drawn linkages between poor crop and its effect on income earnings of farmers particularly men. This subsequently affects men's contribution to the household budget negatively, and thus often creating conflicts and antagonism among household members (Egyir et al., 2014; Wrigley-Asante et al., 2017).

It became apparent during FGDs that men's inability to support the home was due to crop failure which had direct effect on their earnings as farming is their major economic activity. The subsequent conflicts that these reduced earnings create in the household was captured by some participants as:

There is a lot of fighting and divorce cases between couples and within families in our communities nowadays because a lot of men are not able to cater for the basic needs of the family especially children's education, due to poor harvest. Often, the women get stressed up, if they have to shoulder all the household responsibilities alone (A male farmer, KpMu).

Family conflict has increased because most men cannot take care of their responsibility of giving housekeeping money to their wives and catering for the children. This has become a habit and women shoulder all the household needs in addition to the household chores. It has now become a big burden to carry hence arguments and disagreements surface in homes (A female farmer, KAPND).

Food debt and waste of resources as socio-economic effects showed no significant relationship with gender in KAPND ($p>0.05$), KpMu ($p>0.05$) and both KAPND and KpMu ($p>0.05$), considering the fact that there are no variations in responses given by

both sexes (see Table 5.2). This could be because debt incurred as a result of food crop failure cannot be aligned with a specific sex; neither can waste of resources be associated with a specific sex. However, both can lead to scarcity and hunger, forcing farmers to borrow from both formal and informal sources to cater for the needs of the family. Borrowing however could also create challenges for farmers as many are not able to pay back, thus contributing to the psychological effects of farmers. Importantly, a range of household characteristics were found to be affecting agricultural production of smallholder farmers (Ayivor et al., 2015). These factors direct the pace and type of adaptive approaches farmers adopt in improving their food production levels.

5.4: PSYCHOLOGICAL EFFECTS OF CLIMATE CHANGE AND VARIABILITY ON FARMERS

The psychological impact of climate change and variability cannot be underestimated. It is generally argued that the vicissitude associated with climate change and variability can result in serious post-traumatic stress and other related psychological effects on farmers (Ndamani & Watanabe, 2016). Clayton et al. (2014) suggest that this can have effect on the health and welfare of farmers thereby impacting on their ability to cope with and adapt to climate change. Nitschke et al. (2011) established that extreme weather conditions like heat waves, bush fires and drought may be associated with behavioural and mental disorders. In addition, Clayton et al. (2014) assert that key mental health impacts as a result of climate change impact include increase in the incidence of stress, anxiety and depression as well as increases in severe reactions like Post-Traumatic Stress Disorder (PTSD).

Against this background, the study further sought the need to ascertain the various psychological effects of climate change effect on selected farmers (respondents) in

KAPND and KpMu. This was examined in relation to gender of respondents in the selected districts. Psychological effects such as mental stress, loss of status, loss of confidence, inferiority complex, lack of concentration and physical weakness were identified by respondents. The results are presented in Table 5.3.

Evidence from Table 5.3 shows that majority (55.9%) of respondents' revealed inferiority complex as the major psychological effect, followed by lack of concentration (49.3%) and loss of status (41.7%) in the advent of climate change and variability effect. Loss of confidence (21.1%) and physical weakness (26.4%) were the least reported in terms of the psychological effect associated with climate change impact. In addition, 30.2 percent of respondents were of the view that mental stress is one of the major psychological effect associated with climate change and variability effect. At the district level, whereas a higher percentage of respondents from KAPND reported mental stress (45%) and loss of status (45.6%) as major psychological effects of climate change and variability effects, a higher percentage of respondents from KpMu stated inferiority complex (72.4%) and lack of concentration as major psychological effects, which could have serious implications on a farmer's health. It was reported in this study that some men who are not able to stand the effect of climatic changes on the productive activities and its subsequent implications take up drinking and other negative habits that lead to health complications eventually.

Table 5.3: Relationship between psychological effects of climate change and variability and sex in KAPND & KpMU

Study site		Psychological Effects					
		Mental Stress	Loss of Status	Loss of confidence	Inferiority Complex	Lack of concentration	Physical weakness
KAPND	Male	72 (48.3%)	70 (47.0%)	57 (38.3%)	62 (41.6%)	46 (30.9%)	16 (10.7%)
	Female	62 (41.6%)	66 (44.3%)	54 (36.2%)	54 (36.2%)	51 (34.2%)	12 (8.1%)
	Sub-total	134 (45.0%)	136 (45.6%)	111 (37.2%)	116 (38.9%)	97 (32.6%)	28 (9.4%)
KpMu	Male	29 (18.5%)	57 (36.3%)	12 (7.6%)	114 (72.6%)	108 (68.8%)	71 (45.2%)
	Female	20 (13.2%)	60 (39.7%)	5 (3.3%)	109 (72.2%)	94 (62.3%)	61 (40.4%)
	Sub-total	49 (15.9%)	117 (38.0%)	17 (5.5%)	223 (72.4%)	202 (65.6%)	132 (42.9%)
Both (KAPND & KpMu)	Male	101 (33.0%)	127 (41.5%)	69 (22.5%)	176 (57.5%)	154 (50.3%)	87 (28.4%)
	Female	82 (27.3%)	126 (42.0%)	59 (19.7%)	163 (54.3%)	145 (48.3%)	73 (24.3%)
	Total	183 (30.2%)	253 (41.7%)	128 (21.1%)	339 (55.9%)	299 (49.3%)	160 (26.4%)

Source: Fieldwork (2016)

Some farmers could hardly relate their stressful condition to hardship emanating due to crop failure or bush fires destroying their harvest. A few never foresaw any linkage until it happened to them as a farmer with a stroke commented:

After analysing critically, I am inclined to believe that my stroke has something to do with the stressful conditions and humiliations I went through from the banks because I could not repay my loan as scheduled due to crop failure. And the bank without any mercy auctioned my grinding mill, which had been my main source of regular income for some time now” (A male farmer, KAPND).

The views expressed by the farmer re-affirm the fact that there are other non-climatic stressors being social, economic, environmental or political dimensions that could compound the effects of climatic changes on farmers (Ayivor et al., 2015). This shows that

extreme climatic conditions could at times impact negatively on the health of people including women (especially pregnant) and children due to the indirect effects of malnutrition making them susceptible to diseases (Goh, 2012).

In terms of gender variation in responses, a higher percentage of both male and females were of the view that inferiority complex and lack of concentration are the major psychological effects associated with climate change and variability (see Table 5.3). In addition, more males (33%) than females (27.3%) suggested mental stress as a psychological effect of climate change and variability. The situation is more serious among men because it creates a challenge for them in performing their traditional expected roles at the household level. This ultimately results in lack of self-confidence as explained by these men:

Debt due to poor yield can make one worry; give mental stress and loss of status because you cannot perform your legitimate duties in the home especially providing assistance during emergency situations (A male farmer, Donkorkrom, KAPND).

I feel more humiliated when the respect due me as a man is taken for granted. This happens when a man is not able to shoulder his financial bills at home as well as at the community level. The worst is to see your wife and children disregarding your commands because of your inability to take care of them. It causes stress that could lead to sicknesses (A male farmer, KpMu).

This feeling of humiliation can be tied to male identity, masculinity and self-esteem and its implications at the household level (Wrigley-Asante 2008). The results presented thus far lends support to the study by Ndamani and Watanabe (2016) where they generally argued that the unexpected associated with climate change and variability can lead to post-traumatic stress and other related psychological effects on farmers.

It was also found that women also go through stress and lack concentration. It came to the fore that in the short term, women carried most of the burdens taking care of the home and at the same time undertaking their reproductive tasks. This is because most women

actively undertook diverse income-generating ventures including menial jobs like charcoal burning, petty trading, and wild fruits picking, and fetching water for different households for money to be able to take care of the children. The majority of the women explained why a woman would have to move heaven and earth to make sure the family's basic needs are supplied to the best of her ability as follows:

Seeing your child crying out of hunger can drive any responsible woman crazy, not to mention seeing your child sick or dying without money to send him/her to the hospital. A woman will go to the ends of the earth for a cure (A female farmer, KpMu).

This, however, increases the traditional workload contributing to stress for the women. In some instances, some men migrate and this has significant effect on the women left behind as they have to work hard to cater for their children, all contributing to some psychological effects on women.

5.5 SUMMARY

This chapter presented analyses and discussions on the effects of climate change and variability on the livelihood of farmers in KAPND and KpMu. The climate change and variability effects were examined in the context of physical, socio-economic and psychological effects.

In relation to the physical effects of climate change and variability on farming activities in KAPND and KpMu, reduction in crop productivity (51%), and disease outbreak (44.6%) were reported as the main physical effects. With regards to the sex of respondents, whereas majority of male respondents (55.2%) indicated reduction in crop productivity as the major

physical effect of climate change and variability, majority of female respondents (50.0%) stated disease infestation as the major physical effect.

In terms of the socio-economic effects of climate change and variability on farmers, respondents identified several socio-economic effects including waste of resources (28.2%), increased hunger and weakness (37.3%), food debts (23.2%), increased family conflict (49.0%) and out-migration (40.9%). With regards to the psychological effects, respondents reported mental stress (30.2%), loss of status (41.7%), inferiority complex (55.9%) and lack of concentration (49.3%) as the main effects. At the district level, whereas a higher percentage of respondents from KAPND reported mental stress (45%) and loss of status (45.6%) as major psychological effects of climate change and variability effects, a higher percentage of respondents from KpMu stated inferiority complex (72.4%) and lack of concentration as major psychological effects. Also, higher percentage of both male and females stated inferiority complex and lack of concentration as the major psychological effects associated with climate change and variability.

CHAPTER SIX

ADAPTIVE STRATEGIES OF MEN AND WOMEN SMALLHOLDER FARMERS IN COPING WITH CLIMATE CHANGE AND VARIABILITY EFFECTS

6.1 INTRODUCTION

This chapter analyses and discusses results of the field data based on the relative adaptive strategies adopted by farmers to cope with incidence of various climate change and variability effects in KAPND and KpMu. The first section discusses the adaptive strategies often adopted to cope with incidence of crop damage and reduction in crop productivity as a result of changes in climatic condition. This will include discussions on crops mostly affected by climate change and variability impact, autonomous and anticipatory adaptive strategies often adopted to adapt to these effects. The second section further discusses the anticipatory or planned adaptive strategies often adopted to cope with incidence of temperature increase and heat stress in KAPND and KpMu. The last section presents a detailed analyses and discussions on the determinants of adaptive capacity of farmers to cope with climate change and variability effects in KAPND and KpMu. These analyses and discussions were done in relation to the sex of respondents.

6.2 GENDERED RELATIVE ADAPTIVE STRATEGIES TO COPE WITH INCIDENCE OF CROP DAMAGE AND REDUCTION IN CROP PRODUCTIVITY

The rising threats of food insecurity as a result of variability and changes in climatic conditions cannot be overemphasized, especially in tropical regions (Tachie-Obeng, 2012). Several reports including that of IPCC in 2014 have underscored the fact that there are severe challenges to crop production and smallholder farmers' ability to cope with increasing temperature, unpredictable rainfall as well as decreasing rainfall amounts in some cases (Kakota, 2011; Tachie-Obeng, 2012). In the wake of these challenges,

Dankleman (2011) suggests that the negative effects of climate change conditions have different impacts and magnitudes with respect to gender in most tropical and/or developing countries due to varying social and economic dynamics. This notwithstanding, Tachie-Obeng (2012) argues that climate change adaptation is crucial for livelihood improvement and national development, especially in developing countries like Ghana where crop production is mainly rain-fed and the main food crops grown in the zone include cassava, maize, cowpea, rice, vegetables and groundnuts. In view of this, this section begins with an analysis of the various crops that are mostly damaged as a result of changes in climatic conditions over the years. The result is presented in Figure 6.1.

The result shows that cassava is the major crop (52.1%) affected by climate change and variability impact, followed by maize (34.3%) and cowpea (8.6%). Cassava is basically the staple food for majority of people in Ghana and in particular within the FSTZ, with estimated per capita food consumption of 151.4kg (Sagoe, 2006). It is a major source of food and income for individual farmers and government. Cassava can generally stand the bad weather condition and thrives in the zone so it is largely cultivated in large quantities in the area. Because, it is a staple food, almost every household owns a piece of cassava farm to feed at least the family. Moreover, most farmers mentioned that it could be harvested as and when appropriate, and can even be left in the soil for about a year or two after maturity without any problem. Unfortunately, during extreme climatic conditions like drought resulting into bush fires, plantations of cassava could totally be destroyed. Both the roots (tubers) and the sticks could be destroyed without measure leaving farmers in great financial difficulty. A farmer whose cassava farm was affected by bushfires had this to say:

Though, the reduction in rainfall pattern has negatively been affecting our crop yield as farmers for the past 5 years, this year's bush fires due to the long drought has shattered my dreams. For my three (3) acre cassava farm to be totally

destroyed by fire is beyond my understanding. How to pay the loan I took last year is a problem and what can we use in cooking fufu (our staple)? Worse of all, getting new cassava sticks to re-plant means travelling to far away districts to buy them (A female farmer, KAPND).

The worrying situation was confirmed by the Agricultural Extension Officer at Donkorkrom who said, the only way out is helping farmers to create wide fire belts around their farms to reduce easy spread of wild fires. This initiative resonates with the notion that activities by smallholder farmers is enabled or hindered by the institutional context of livelihoods. In this case the local institution (agricultural extension) is enhancing the adaptive capacities of farmers by teaching them how to create fire belts among others in improving their livelihoods at the face of climatic changes which is critical (Scoones, 1998; Agrawal & Perrin, 2008; Ellis, 2000; Kakota et al., 2011).

Besides, cassava is bulky and has shorter shelf-life after harvest so farmers risk harvesting large quantities without ready market. Hence, over 90 percent of farmers prefer leaving their cassava farms unharvested until demand is placed. It was observed that the good time of harvesting was during the raining season where the ground is soft enough to uproot easily. It was further observed that, few farmers process cassava into gari (cassava flakes) and cassava dough which have longer shelf life comparatively and sell them during market days. On market days, farmers' often barter food stuff (like cassava dough, gari among others) for fish from the fisher folks from the lake-side as an adaptation strategy for dry season if none of the parties have money.

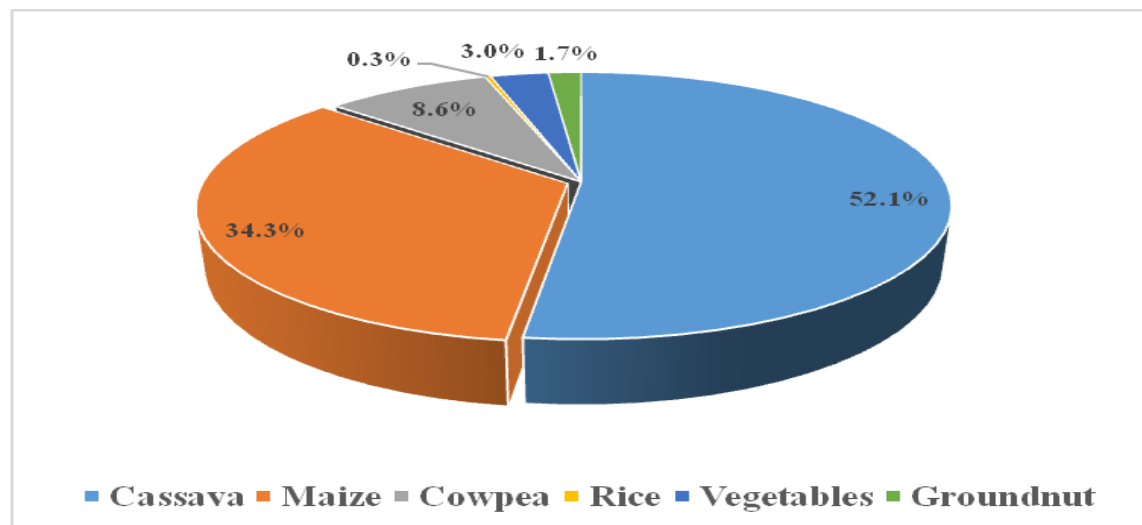
Importantly, socio-economic drivers like poor human health, and out migration were identified to be able to affect cassava production by reducing labour availability and quality. This resonates with Sagoe's findings about how root crop production in Ghana are affected by some key socio-economic drivers (Sagoe, 2006). The plight of farmers in

KAPND for instance, is worse because of the wanton destruction of farms by cattle herds that graze through most farms in addition to the climatic challenges.

The results further show that rice (0.3%), vegetables (3.0%) and groundnut (1.7%) are the least affected crops with regards to the impact of changes in climatic conditions over the years. It was found that these three crops are all early maturing crops with life span ranging between three (3) months to one (1) year. Thus, such crops if managed well could be harvested before extreme weather sets in.

Rice is mainly cultivated in the valleys and wetlands with less threat from droughts and dryness of soil because of reduction in rainfall. However, once a while sporadic rains with floods could cause serious destruction to farms within these low grounds. Further, the wetlands are used for dry season farming of vegetables including okro, cabbage, garden eggs, pepper, tomatoes on small scale (between ½ - 1 acre) per farmer. Women are the majority in this but in areas where an irrigation component is added like in KAPND, it was taken over by men because of the high cost of the pumping machines, which most women farmers could not afford.

Figure 6.1: Crops mostly affected by changes in climatic conditions



Source: Fieldwork, 2016

Given the fact that climate change and variability are noted to occasion incidence of water and heat stress, exacerbate incidence of pests and diseases and drought, and amplify food insecurity (Yaro, 2009; Bawakyillenuo et al., 2014), adaptation to these risks has been given much credence over the years. Depending on the reason for its implementation, the timing or degree of spontaneity, adaptation to climate change and variability effects could either be autonomous or anticipatory in nature. Some studies suggest that whereas autonomous or reactive adaptive strategies are mostly undertaken by individuals in response to risks associated with climate change, anticipatory or planned adaptive strategies are more often undertaken by governments or institutions in anticipation of climate related hazards or effects (Todaro & Smith, 2012). It would also suffice to underscore the fact that, regardless of the time and the scale at which adaption takes place, adaption is highly contingent on one's capacity to adapt (IPCC, 2007).

Considering the fact that majority of the crops cultivated within the districts selected are affected by the impact of climate change and variability, an attempt was made to examine how farmers respond or react to incidence of crop damage and reduction in crop productivity in KAPND and KpMu. This was towards the ascertainment of various reactive or autonomous relative adaptive strategies respondents adopt. The results, presented in Table 6.1, show that 34 percent of respondents sampled engage in off-farm activities such as charcoal burning, trading among others, as an autonomous response to climate change and variability effect on crop production whereas 11.2 percent of respondents indicated that they do not adapt. The results also show that 22.8 percent of respondent migrate to other communities in search of other jobs and 13.5 percent rely on remittances as a reactive adaptive strategy to effects of changes in climatic condition on crop production. From the FGDs, some women were of the view that most of the men migrate and leave behind the women to take care of the children (Wrigley Asante et al.,

2017). Nelson and Stathers (2009) confirm that crop failure due to decline in rainfall, soil fertility and increase in the crop and pest diseases among others have forced young men to migrate to nearby cities as an adaptive strategy in Tanzania.

Table 6.1: Relationship between sex and autonomous/reactive relative adaptive strategies to climate change and variability effects

Study site	Sex	Reported Reactive Adaptive Strategies to Crop Damage				
		Nothing	Change in agronomic practices	Migrate in search of other jobs	Engage in off-farm activities	Rely on remittances
KAPND	Male	19 (12.8%)	29 (19.5%)	49 (32.9%)	34 (22.8%)	24 (16.1%)
	Female	18 (12.1%)	39 (26.2%)	51 (34.2%)	34 (22.8%)	25 (16.8%)
	total	37 (12.4%)	68 (22.8%)	100 (33.6%)	68 (22.8%)	49 (16.4%)
KpMu	Male	19 (12.1%)	7 (4.5%)	19 (12.1%)	78 (49.7%)	16 (10.2%)
	Female	12 (7.9%)	16 (10.6%)	19 (12.6%)	62 (41.1%)	17 (11.3%)
	total	31 (10.1%)	23 (7.5%)	38 (12.3%)	140 (45.5%)	33 (10.7%)
Both (KAPND & KpMu)	Male	38 (12.4%)	36 (11.8%)	68 (22.2%)	112 (36.6%)	40 (13.1%)
	Female	30 (10.0%)	55 (18.3%)	70 (23.3%)	96 (32.0%)	42 (14.0%)
	Total	68 (11.2%)	91 (15.0%)	138 (22.8%)	208 (34.3%)	82 (13.5%)

Source: Fieldwork (2016)

In addition, 15 percent of respondents resort to changing agronomic practices such as shifting cultivation and fallowing of land to the use of new drought resistant crop varieties in maize, okra, cassava, and the use of chemical fertilisers as key agronomic adaptation strategies. The practice was to improve yield since most traditional crops have given way to improved varieties. It was also observed that more than 90 percent of both male and female farmers time the rains and therefore do early or late planting depending on the first

rainfall. This trend could be linked to regular reports on increases in rainfall variability and early stoppage of rainfall in the FSTZ (Owusu & Waylen, 2013). These actions by farmers' resonates with the livelihood principle of differentiated response of farmers in coping and building resilience strategies in the face of climatic hazards like fluctuation in rains that seriously affects their crop yields (Kakota et al, 2011).

In terms of gender variation in reactive adaptive strategies, a higher percentage of both males (36.6%) and females (35.0%) engage in off-farm activities while more females (18.3%) than males (11.8%) opt to change agronomic practices. Information from the FGDs indicated that while male farmers adopted new and modern agronomic practices as an adaptive strategy, female farmers in the communities being custodians of indigenous knowledge had resorted to old and indigenous agronomic practices as a response to the effects of climate change and variability. Off-farm activities like charcoal burning, firewood harvesting, wild fruits collection were resorted to by most female farmers whenever crops failed. In addition, women mostly resorted to petty trading and menial jobs like water fetching and carting of farm produce for households in need for some income to take care of children and other agricultural works (Hughes, 2012; Wrigley-Asante & Agandin, 2015). From the FDGs, it came out that, most families have reduced the number of meals from three to two or even once a day as a strategy in adjusting to food insecurity challenges due to climatic risks, which resonates with Egyir et al.'s (2014) work on climate change and agricultural adaptation measures in the transitional zone of Ghana. In relation to differences in adaptive strategies at the district level, a higher percentage of respondents from KAPND (33.6%) than KpMu (12.3%) opt to migrate in search of other jobs while a higher percentage of respondents from KpMu (45.5%) as compared to KAPND (22.8%) engage in off-farm activities (see Table 6.1). The trend of the analysis brings out clearly the need of teasing out community and gender

specific climatic related concerns/challenges for planning and policies at all levels. Comparatively, more farmers (22.8%) from KAPND prefer to change their agronomic practices as an autonomous adaptive strategy relative to those from KpMu.

A young male farmer during an FGD at KAPND reiterated in relation to the need to change their agronomic practices as:

The severe changes in the climate nowadays in relation to high temperatures and prolonged dryness are rendering our traditional practices less effective somehow. We are now adapting to the season by cropping new drought resistant varieties. These crops like shallots, okro, pepper among others, are short term and with shallow roots that do not need too much water and long term attention. Though they are labour and input intensive, they are for a short period and the turnover is immediate and high because such vegetables are always in good demand during the dry season. This takes the mind of the youth off migrating to nearby towns to look for jobs that do not exist (a 28 year old male farmer, KAPND).

The changes in the traditional planting practices into more suitable methods affirms the sustainable livelihoods tenet that highlights that farmers' exposure to climatic shocks like drought directs them to the appropriate adaptive strategies composed of different types of activities, some of which may be natural resource based and others may not (Ellis, 2000; Kakota et al, 2011). It also agrees with the structuration theory's principle that human organisation are changeable by human agency (Giddens, 1984; Holt-Jensen, 2009). Thus, when in a population, enough people change their behaviour, then the norm in question is changed because social norms are structures and are dynamic. Hence, as farmers change their agronomic practices because of the changes in temperature and rainfall by adopting new adaptive strategies, the new strategies replace the old ones. And this is not expected to be static but can continue to change with time.

Additionally, the study sought to examine the various anticipatory or planned adaptive strategies respondents undertake in adapting to climate change and variability impact on crop productivity in KAPND and KpMu. This was again assessed in relation to sex of respondents and the results are presented in Table 6.2.

To cope with climate change and variability impact on crop production, 44 percent of respondents resort to the use of weedicides and 24.4 percent of respondents use fertilizers in farming in anticipation of impact of changes in climatic condition on crop productivity. Weedicide use was found to be an easier method of controlling difficult weeds like grass. But a lot of farmers disliked its associated side effect of making the soil hard as well as destroying all non-timber forest products like snails and mushroom that they used as a nutritional supplement. Further, some farmers even hunt it solely for extra income. The weedicide application was also found to be detrimental to the environment and especially farmers' health if appropriate protective clothes were not used as has been highlighted by Wrigley-Asante et al. (2017).

Also, 14.4 percent change the time they plant their crops and 13.5 percent turn to using new variety of seeds for planting. To majority of farmers (both male and female), crop decreases due to rainfall, and temperature variability have negatively affected their incomes so adjusting the planting periods to meet the rains was critical. Only 1.7 percent and 2.3 percent of respondents undertake mixed cropping and planting of trees on the farm respectively as planned adaptive strategies. The typical situation of mixed cropping was intercropping of cassava and maize on the same field. Often, the maize is harvested in three months and cassava after six months or over a year depending on the variety. It makes sure food is available throughout the year at household levels and excesses sold.

Table 6.2: Relationship between gender and anticipatory/planned relative adaptive strategies to climate change and variability effects

Study site	Sex	Reported Anticipatory/Planned Relative Adaptive Strategies					
		Use of Fertilizers	Use of Weedicides	Use of New Variety	On Farm-tree Planting	Change in Planting Time	Mixed Cropping
KAPND	Male	53 (35.6%)	13 (8.7%)	38 (25.5%)	2 (1.3%)	41 (27.5%)	2 (1.3%)
	Female	52 (34.9%)	16 (10.7%)	34 (22.8%)	0 (0.0%)	46 (30.9%)	1 (0.7%)
	total	105 (35.2%)	29 (9.7%)	72 (24.2%)	2 (0.7%)	87 (29.2%)	3 (1.0%)
KpMu	Male	22 (14.0%)	120 (76.4%)	2 (1.3%)	8 (5.1%)	-	5 (3.2%)
	Female	21 (13.9%)	116 (76.8%)	8 (5.3%)	4 (2.6%)	-	2 (1.3%)
	total	43 (14.0%)	236 (76.6%)	10 (3.2%)	12 (3.9%)	-	7 (2.3%)
Both (KAPND & KpMu)	Male	75 (24.5%)	133 (43.5%)	40 (13.1%)	10 (3.3%)	41 (13.4%)	7 (2.3%)
	Female	73 (24.3%)	132 (44.0%)	42 (14.0%)	4 (1.3%)	46 (15.3%)	3 (1.0%)
	Total	148 (24.4%)	265 (43.7%)	82 (13.5%)	14 (2.3%)	87 (14.4%)	10 (1.7%)

$\chi^2=4.48$, df (5), p value= 0.48>0.05

Source: Fieldwork (2016)

With regards to the gender variations, a higher percentage of both males (43.5%) and females (44.0%) indicated that they use weedicides. At the district level, variations in adaptive strategies were very clear. While a higher percentage of respondents in KAPND (35.2%) use fertilizer as a planned adaptive response to climate change and variability impact, majority of respondents in KpMu (76.6%) opt for weedicides.

It was found from the studies that farmers adoption varied according to their location (farming on wetlands or mountains), financial strength (ability to afford fertilisers), sex (traditional sex roles), interests, experiences, responsibilities and other concerns. At any

point in time, farmers adopted the best adaptive options suitable to their local and specific conditions. A participant in a discussion at an FGD with a farmer group that had created an artificial dam using pumping machines in drawing water from the Volta Lake for vegetable cultivation threw light on the diversified preferences of farmers as:

Though we are all farming along this dam, you can see the different types of crops grown by individual farmers, tomatoes, okro, pepper, garden eggs and others. The MOFA Extension Officers come to offer advice on good agronomic practice including the use of weedicides but a few of us have refused to use weedicide and are managing the weeds naturally. In this field, more women are into okro than men, whilst the exotics such as cabbage, lettuce and green pepper are dominated by young male farmers (A male farmer, KAPND).

6.3 PLANNED ADAPTIVE STRATEGIES TO COPE WITH INCIDENCE OF TEMPERATURE INCREASE / HEAT STRESS

Considering the fact that respondents gave much credence to increase in temperature and its resulting impact on crop production as a major effect of climate change and variability in KAPND and KpMu, an attempt was made to examine the various anticipatory or planned adaptive strategies respondents put in place to cope with this effect. Ideally, it is noteworthy to mention that, in anticipation of the impact of temperature increase on crop production and availability of water for farming, some measures will be adopted by farmers to cope with temperature increase. The results of this analysis are presented in Table 6.3.

In view of the water stress and drought associated with temperature increase, 29.7 percent of respondents indicated that they plant drought resistant varieties and a higher percentage of respondents (32.2%) stated that they engage in early planting of their crops. It is in line with a study conducted at Wenchi and Ejura Sekyedumase in the FSTZ of Ghana by Wrigley-Asante et al, (2017), which observed that both male and female smallholder farmers favoured early planting as a management technique of adaptation in addressing

the risks associate with climatic changes. The drought resistant varieties were always accompanied with sensitization and guidance from Agricultural Extension Officers for the right adoption practices. In addition, mixed cropping (31%) was reported as a major adaptive strategy farmers adopt in adapting to climate change and variability effects. For instance, farmers planted different variety of crops like corn, pepper, okra on a small-scale (about an acre) using wetlands and valleys for increased yields. It was found that, women are more involved in this practice, where family consumption is seen as a priority before excesses are sold. It therefore serves as a security measure, in case one of the crops fails. Comparatively, more farmers preferred planting of late maturing varieties (22.8%) to planting early maturing varieties as a planned adaptive strategy to temperature increase. The late maturing varieties are often the traditional ones they are used to. They have rich experience in its management and would not need to depend on any technical expert's advice.

They are masters in that field and as such cut down cost in, for instance, fertiliser use, among others. Because, traditionally a farmer may decide to plant in rows or not, or apply fertilisers or not, without any big challenge. In addition, 16 percent of respondents resort to conserving soil water or mulching and 15 percent adopt rain harvesting as an adaptive strategy in anticipation of the impact of temperature increase on farming activities. This enables farmers to conserve some water for farming purposes, especially in situations where irrigation facilities are non-existent.

The results in Table 6.3 further show that 18.4 percent of respondents use irrigation as a means to cope with the impact of temperature increase while 16.6 percent plant on wetlands. Despite the economic prospects in adopting irrigation facilities to sustain farming, especially vegetable farming throughout the year, majority of the farmers still depend on rain-fed agriculture in spite of the good market for the produce and its potential to reduce unemployment, poverty and food insecurity in the districts.

Opare & Wrigley-Asante, (2008) have indicated that where irrigation facilities possibly through the construction of small dams are available, it could be expensive and women could have limited access to the facilities. This was however not the case in the selected districts. For instance, women in KAPND practicing matrilineal inheritance could own land and prosper as equal as men; even in KpMu where patrilineal inheritance is practiced, women could have free access to land and property equally as their male counterparts, contrary to patriarchy inheritance system that favours men in the northern regions in Ghana (Ogato, Boon and Subramani, 2009; Asif, 2013; Dinko, Haider and Stevens, 2016). It would also suffice to point out that 11.1 percent and 18.1 percent of farmers sampled engage in the planting of trees on the farm and planting on raised ridges respectively. The results suggest that in anticipation of the effects of temperature increase on farming activities, farmers opt to change the variety of seeds they plant or time of planting, find alternative ways of conserving water for crop production, or engage in mitigation measures via tree planting. Even though there is no significant gender variation in planned adaptive measures, more males than females prefer mixed cropping, mulching and rain harvesting as adaptive responses.

A farmer in a FGD indicated:

The only way out for our continuous farming in the face of this serious climatic variability which is beyond farmers' control is to adopt varieties of locally appropriate adaptive strategies for survival, else we are doomed. I have strategized in using both early and late maturing crop varieties among others. And I know quite a number of us are doing the same (A male farmer/ opinion leader, KpMu).

Table 6.3 Relationship between gender and anticipatory/planned relative adaptive strategies to climate change and variability Effects (incidence of temperature increase)

Anticipatory/Planned Adaptive Strategies	KAPND		KpMu		BOTH KAPND & KpMu		
	Male (n=149)	Female (n=149)	Male (n=157)	Female (n=151)	Male (n=306)	Female (n=300)	Total (n=606)
Early Planting	34 (22.8%)	38 (25.5%)	62 (39.5%)	61 (40.4%)	96 (31.4%)	99 (33.0%)	195 (32.2%)
Late Planting	47 (31.5%)	35 (23.5%)	11 (7.0%)	6 (4.0%)	58 (19.0%)	41 (13.7%)	99 (16.3%)
Planting early maturing varieties	34 (22.8%)	32 (21.5%)	3 (1.9%)	6 (4.0%)	37 (12.1%)	38 (12.7%)	75 (12.4%)
Planting late maturing varieties	20 (13.4%)	23 (15.4%)	57 (36.3%)	38 (25.2%)	77 (25.2%)	61 (20.3%)	138 (22.8%)
Drought resistant varieties	27 (18.1%)	19 (12.8%)	62 (39.5%)	72 (47.7%)	89 (29.1%)	91 (30.3%)	180 (29.7%)
Rain Harvesting	25 (16.8%)	22 (14.8%)	24 (15.3%)	17 (11.3%)	49 (16.0%)	39 (13.0%)	88 (14.5%)
Mixed Cropping	28 (18.8%)	19 (12.8%)	73 (46.5%)	68 (45.0%)	101 (33.0%)	87 (29.0%)	188 (31.0%)
Soil water conservation/mulching	16 (13.1%)	19 (15.1%)	35 (22.3%)	17 (11.3%)	51 (18.3%)	36 (13.0%)	87 (15.6%)
Irrigation	21 (16.8%)	18 (14.2%)	31 (19.7%)	33 (21.9%)	52 (18.4%)	51 (18.3%)	103 (18.4%)
Planting on raised ridges	35 (24.3%)	30 (20.5%)	24 (15.3%)	19 (12.6%)	59 (19.6%)	49 (16.5%)	108 (18.1%)
Planting on wetlands	15 (12.0%)	11 (8.7%)	36 (22.6%)	31 (20.5%)	51 (18.1%)	42 (15.1%)	93 (16.6%)
On-farm tree planting	16 (10.7%)	10 (6.7%)	19 (12.1%)	22 (14.6%)	35 (11.4%)	32 (10.7%)	67 (11.1%)

Source: Fieldwork (2016)

6.4 DETERMINANTS OF ADAPTIVE CAPACITY OF SMALLHOLDER FARMERS TO COPE WITH CLIMATE CHANGE AND VARIABILITY EFFECTS

Within the ambit of the adaptive capacity framework, a system's capacity to adapt to climate change impact is largely contingent on three main dimensions - viz. awareness, ability and action (IPCC, 2007; Juhola et al., 2012). The determinants of these dimensions include knowledge and awareness, technology, infrastructure, institutions and economic resources. Asante et al. (2012) opine that an individual's capacity to adapt is invariably reliant on the knowledge on the need to adapt; being aware of the problem; level of technology, socio-economic features including age, income and education; access to certain infrastructure and the level of institutional support. These determinants are not mutually exclusive but rather complementary of each other (Asante et al., 2012; Juhola et al., 2012). Towards a comprehensive examination of the various adaptive strategies adopted by farmers to cope with the effects of climate change and variability in KAPND and KpMu, some determinants of the adaptive capacity of male and female smallholder farmers were assessed. Given the fact that the adaptive capacity framework underscores the relevance of various determinants such as economic resources, access to infrastructure and institutions, the adaptive capacity of farmers were examined in relation to access to credit, their role in decision making, and social capital and effectiveness of institutions. Within the spatial context of this study, these determinants are noted to influence the adaptive capacity to cope with climate and variability effects. The role and effectiveness of various institutions will be thoroughly examined in the next chapter.

6.4.1 Access to Credit

In the event of climate change and variability effect, it can be argued with no equivocation that the ability to adapt or cope is highly dependent on resources, especially capital or credit. Satterthwaite et al. (2007) suggest that resources are integral in the

planning, implementation and building of strategies if one needs to adapt. Some studies depend on economic resources such as the resource base or assets of respondents as a relative measure of wealth in examining relationship between economic resources and relative adaptive strategies. Access to credit for farming was used in this context, considering the fact that access to credit would aid in the planning, implementation and building of strategies (Satterthwaite et al., 2007). The results are presented in Table 6.4.

Out of the 606 respondents sampled, majority (51.5%) do not have access to credit whereas 48.5 percent have access to credit for farming. From the FGDs, majority of farmers find it difficult to access credit from Commercial Banks including Rural Banks because these banks had requested each farmer who needed a loan to bring at least one civil or public servant with a regular monthly salary to act as guarantor as a requirement for loans. The banks had taken that rigid stand because most farmers on a number of occasions have reneged in paying back these loans due to crop failure and therefore the guarantors had to stand in to settle these loans. As such, the salaried workers in the community are not willing to guarantee again for the fear of the unpredictable weather conditions. This applies to both male and female farmers. Even though there is no significant relationship between sex and access to credit ($p>0.05$) as majority of both males and females do not have access to credit for farming, (see Table 6.4), more females than (49.3%) than males (47.7) have access to credit. Relatively, majority of respondents in KAPND (55.7%) have access to credit than those in KpMu (44.3%).

The results from the study suggest that majority of farmers do not have access to credit for farming, especially in KpMu. This further shows the low adaptive capacity of farmers in terms of access to credit in the event of climate change and variability impact. A woman farmer expressed this frustration in an interview:

With the adoption of the new crop varieties including the exotics that have ready market, a farmer needs soft loans. But because I don't have any collateral or any public worker to guarantee the loan as requested by the Rural Banks, I am keeping to the loans from private individuals which are too exorbitant and with unfriendly terms. We need a saviour else, it is becoming difficult to feed our families, let alone paying our children's school fees (A female farmer, KpMu).

The difficult conditions farmers encounter in accessing credit resonates with increased calls for need to analyse the range of formal and informal organizational and institutional factors that influence sustainable livelihood outcomes. For instance, how patterns of assets including credit or financial control depicts the ability of people to withstand shocks as well as influence adaptive capabilities of farmers (Chambers & Conway, 1992; Ellis, 2000).

Table 6.4: Relationship between gender and access to credit

Study site	Sex	Access to Credit		Total
		Yes	No	
KAPND	Male	81 (54.4%)	68 (45.6%)	149 (100.0%)
	Female	85 (57.0%)	64 (43.0%)	149 (100.0%)
	Sub-total	166 (55.7%)	132 (44.3%)	298 (100.0%)
	$\chi^2=0.22, df (1), p \text{ value}= 0.64>0.05$			
KpMu	Male	65 (41.4%)	92 (58.6%)	157 (100.0%)
	Female	63 (41.7%)	88 (58.3%)	151 (100.0%)
	Sub-total	128 (41.6%)	180 (58.4%)	308 (100.0%)
	$\chi^2=0.33, df (1), p \text{ value}= 0.95>0.05$			
Both (KAPND & KpMu)	Male	146 (47.7%)	160 (52.3%)	306 (100.0%)
	Female	148 (49.3%)	152 (50.7%)	300 (100.0%)
	Total	294 (48.5%)	312 (51.5%)	606 (100.0%)
$\chi^2=0.16, df (1), p \text{ value}= 0.69>0.05$				

Source: Fieldwork (2016)

Against the backdrop that 48.5 percent of respondents have access to credit (see Table 6.4), an attempt was made to examine the amount they are able to access as credit. This was examined in relation to the sex of respondents in KAPND and KpMu. The results (see Table 6.5) show that a higher percentage of respondents are able to access GH¢501- GH¢1000 (48.3%) and more than 2,000 Cedis (36.4%). Conversely, less than 5 percent of respondents are able to access GH¢1,100 - GH¢1,500 (1.7%) and GH¢1,501- GH¢2,000 (2.7%). The results on Table 6.5 further shows that access to credit is not aligned to a specific sex as there are no variation in the amount both males and females access in both districts. Farmers irrespective of their sex could have access to loans so long as they meet the requirements on the loans.

At the district level, whereas majority of respondents (60.2%) in KAPND are able to access more than GH¢2,000 as credit, 84.4 percent of respondents KpMu are able to access GH¢501- GH¢1,000. This suggests that majority of farmers in KAPND have access to higher credit amounts than those in KpMu. This could be as a result of differences in financial institutions in both districts as banks are able to give out more credit as compared to microfinance and money lenders. The results on Table 6.6 show that a higher percentage of respondents in KAPND access their credit from banks relative to those in KpMu who depend on microfinance and money lenders for credit. In sum, it could conclude that majority of farmers in both districts do not have access to soft loans to aid them in planning, implementation and building of resilient adaptive strategies. This lends support to the weak adaptive capacity of farmers to climate change and variability effect. It agrees with the fact that financial support for modern day farming is critical as observed by a farmer:

With decrease in rainfall, dryness of the soil and increase in pest and disease infestation of crops leading to low yields in harvesting, farmers have no choice than to take the advice of MOFA Extension Officers to adopt the improved methods of farming. But the use of artificial fertilisers, irrigation system, new crop varieties etc go with cost. Those of us who cannot afford but can also not have access to soft loans are left to our fate (A young male farmer, KpMu).

The views of this farmer resonate with the discussions that differentiated access to livelihood assets like financial support could highly influence the adaptation or coping strategies farmers could adopt (DFID, 2000; Ellis, 2000; Kakota et al., 2011). For instance, the above mentioned farmer could be forced to migrate or take up another off-farm activity like charcoal burning if he is not able to get any financial support to undertake the improved farming method he has been advised to do.

Table 6.5: Relationship between sex and amount of money accessed

Study site	Sex	Amount of Credit Accessed in GH ₵					Total
		100 - 500	501 - 1,000	1,001 - 1,500	1,501 - 2,000	Over 2000	
KAPND	Male	12 (14.8%)	15 (18.5%)	4 (4.9%)	1 (1.2%)	49 (60.5%)	81 (100.0%)
	Female	8 (9.4%)	19 (22.4%)	1 (1.2%)	6 (7.1%)	51 (60.0%)	85 (100.0%)
	Sub-total	20 (12.0%)	34 (20.5%)	5 (3.0%)	7 (4.2%)	100 (60.2%)	166 (100.0%)
KpMu	Male	5 (7.7%)	55 (84.6%)	-	1 (1.5%)	4 (6.2%)	65 (100.0%)
	Female	7 (11.1%)	53 (84.1%)	-	0 (0.0%)	3 (4.8%)	63 (100.0%)
	Sub-total	12 (9.4%)	108 (84.4%)	-	1 (0.8%)	7 (5.5%)	128 (100.0%)
Both (KAPND & KpMu)	Male	17 (11.6%)	70 (47.9%)	4 (2.7%)	2 (1.4%)	53 (36.3%)	146 (100.0%)
	Female	15 (10.1%)	72 (48.6%)	1 (0.7%)	6 (4.1%)	54 (36.5%)	148 (100.0%)
	Total	32 (10.9%)	142 (48.3%)	5 (1.7%)	8 (2.7%)	107 (36.4%)	294 (100.0%)

Source: Fieldwork (2016)

The study also sought to examine the various sources through which respondents are able to access credit in KAPND and KpMu. Again, this was examined in relation to the sex of respondents. The results are presented on Table 6.6. Money lenders (31.3%) and Microfinance institutions (26.5%) serve as the major sources of credit for a higher percentage of the respondents. Friends (6.1%) and relatives (12.9%) also provide some buffer in giving credit to some farmers. In addition, 21.1 percent of respondents indicated that they access credit via the bank. The results indicate that microfinance, money lenders, relatives and friends provide some cushion for farmers in terms of providing credit for their farming activities. It was also observed that more males (36.3%) depend on money lenders for credit than females (26.4%) whereas more females (17.6%) depend on relatives for credit than males (8.2%). It came out that loans from the relatives did not often attract interest and had flexible terms of repayment and female farmers were seen to be more reliable in keeping to their promises concerning repayments. Similarly, in KpMu for example, more males (35.4%) depend on money lenders for credit than females (19.0%) (See Table 6.6). Banks serve as the major source of credit for a higher percentage of farmers in KAPND (38.0%) as compared to KpMu (3.9%). This explains why that higher percentage of the respondents in KAPND is able to access high sums from banks as compared to those in KpMu (see Table 6.5).

In KAPND, most of the farmers (both male and female) have bought or rented vast lands for intensive farming basically for commercial purposes. They are often ready to go for bank loans regardless of the interest and take advantage of all possible growth opportunities in the area as reiterated by a farmer during an FGD session:

I have resorted to approaching Afram Plains Rural Bank for loans annually because, they are reliable, though their interest rate is high (18% for 6 months). I combine the wetlands farming of exotics vegetables with the traditional ones. I try repaying the loans in bits after every harvest which, reduces the pressure in paying in bulk as well as minimising defaulting. We are therefore appealing to government and other organisations to come to our aid to enable us expand our farms (A male farmer and leader, KAPND).

Table 6.6: Relationship Between Sex and Sources of Credit Obtained

Study site		Sources					Total
		Bank	Microfinance	Money Lender	Relative	Friend	
KAPND	Male	33 (40.7%)	16 (19.8%)	30 (37.0%)	0 (0.0%)	2 (2.5%)	81 (100.0%)
	Female	30 (35.3%)	27 (31.8%)	27 (31.8%)	1 (1.2%)	0 (0.0%)	85 (100.0%)
	Sub-total	63 (38.0%)	43 (25.9%)	57 (34.3%)	1 (0.6%)	2 (1.2%)	166 (100.0%)
KpMu	Male	3 (4.6%)	20 (30.8%)	23 (35.4%)	12 (8.5%)	7 (10.8%)	65 (100.0%)
	Female	2 (3.2%)	15 (23.8%)	12 (19.0%)	25 (39.7%)	9 (14.3%)	63 (100.0%)
	Sub-total	5 (3.9%)	35 (27.3%)	35 (27.3%)	37 (28.9%)	16 (12.5%)	128 (100.0%)
Both (KAPND & KpMu)	Male	36 (24.7%)	36 (24.7%)	53 (36.3%)	12 (8.2%)	9 (6.2%)	146 (100.0%)
	Female	32 (21.6%)	42 (28.4%)	39 (26.4%)	26 (17.6%)	9 (6.1%)	148 (100.0%)
	Total	68 (23.1%)	78 (26.5%)	92 (31.3%)	38 (12.9%)	18 (6.1%)	294 (100.0%)

Source: Fieldwork (2016)

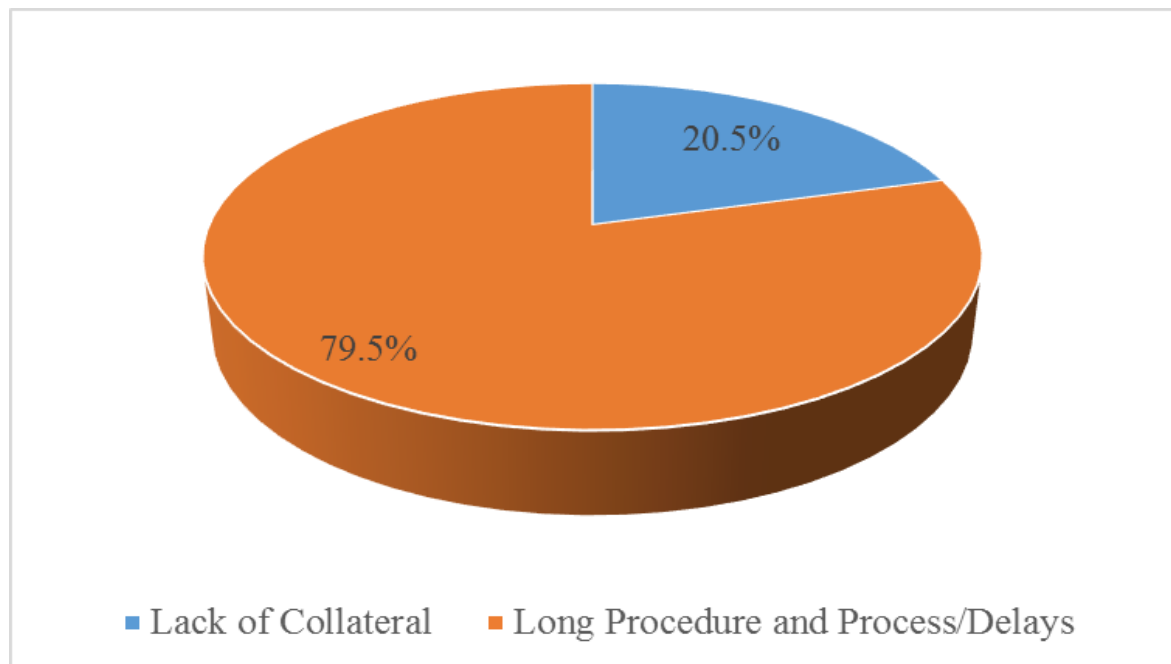
Of the number of respondents that indicated that they do not have access to credit, 79.5 percent revealed lack of collateral as the main reason why they cannot access credit. Also, 20.5 percent were of the view that, high interest rates from banks are one of the reasons why they cannot access credit.

Women farmers in both districts found an alternative way of addressing this collateral challenge by forming solidarity groups in savings, where women saved an agreed amount regularly (monthly or after every harvest), and loan it to one another with agreed terms of conditions for payment and repayments. The money keeps revolving until each member gets her turn with very low interests. In KpMu, the process was facilitated by the MOFA Extension Officers who linked the groups to the Commercial Banks to do the

disbursement for them with a small fee. This alternative source of credit (Susu) system was serving as a big financial relief for many women smallholder farmers.

It also came out from the FGDs that most women were not very comfortable with the extent of documentation associated with granting of loans at the banks. Considering the low educational background of these women farmers, they often get frustrated and embarrassed in going through such complicated processes. It further, lowered their confidence levels.

Figure 6.2: Reasons for not accessing credit



Source: Fieldwork, 2016

6.4.2 Role in decision making

The role an individual plays in the decision making processes of programmes affecting their farming activities influence their capacity to adapt to climate change and variability effects. A farmer can adapt to climate change and variability effect depending on their involvement in the making of decisions that affects their livelihoods. In view of this, the active involvement of male and female farmers in the decision making processes of programmes affecting farmer's livelihoods was examined. Respondents were asked if men and women are equally involved in making decisions affecting their farming activities. The results of this are presented in Table 6.7.

Majority of respondents (55.4%) reported that men and women play equal roles in making decisions affecting their livelihoods while 38 percent indicated the converse. Women's high involvement in the study, is contrary to the observation made by Ardayfio-Schandorf, (1994) and Wrigley-Asante, (2008) about women's exclusion and under representation in the decision-making at the household level on adaptation strategies. Women's active engagement in off-farm adaptive activities like petty trading is positively influencing their social status at home and community levels (Wrigley-Asante et al, 2017). It was found that women in the communities contributed to decisions on household needs, children's education, healthcare and daily meals. This confirms the argument that women's ability to support the family financially improves their decision-making positions (Wrigley-Asante et al., 2017).

Less than 10 percent of respondents had no idea. This suggests that there are no variations in the adaptive capacity of male and female farmers in terms of the role they play in decision making. A comment by a female farmer during FGDs stressed how women's views are respected when their economic status' get improved:

Unlike the olden days, now most women are consulted and involved in household decision-making processes because they have money to supplement the family incomes. At times, their contributions are even higher than their male counterparts (A female farmer, KAPND).

It came out from the FGDs that adult children and adult family members also contributed to decisions on family livelihood activities. The few women who usually took decisions on their own were mostly household heads who were most often divorced, separated, widowed or single as also the works of Kabeer (1998) Wrigley-Asante (2012) and Wrigley-Asante et al. (2017).

Table 6.7: Relationship between sex and level of involvement in decision making

Study site	Sex	Equal involvement of Men and Women in Decision			Total
		Equally Involved	Not Equally Involved	No idea	
KAPND	Male	109 (73.2%)	38 (25.5%)	2 (1.3%)	149 (100.0%)
	Female	103 (69.1%)	43 (28.9%)	3 (2.0%)	149 (100.0%)
	Sub-total	212 (71.1%)	81 (27.2%)	5 (1.7%)	298 (100.0%)
KpMu	Male	60 (38.2%)	77 (49.0%)	20 (12.7%)	157 (100.0%)
	Female	64 (42.4%)	72 (47.7%)	15 (9.9%)	151 (100.0%)
	Sub-total	124 (40.3%)	149 (48.4%)	35 (11.4%)	308 (100.0%)
Both (KAPND & KpMu)	Male	169 (55.2%)	115 (37.6%)	22 (7.2%)	306 (100.0%)
	Female	167 (55.7%)	115 (38.3%)	18 (6.0%)	300 (100.0%)
	Total	336 (55.4%)	230 (38.0%)	40 (6.6%)	606 (100.0%)

Source: Fieldwork (2016)

6.4.3 Social Capital

The report by IPCC (2011) on the determinants of adaptive capacity gives much cognisance to social factors including social capital and networks as key components that affect the capacity of an individual to adapt to climate change and variability. In this context, respondents' social capital was examined in relation to the various social organisations they belong to and if they get assistance or support from these organisations in the event of any climate change and variability impact. These social organisations were used as proxies for farmers' social capital largely because most of these organisations are formed to provide assistance and also serve as the immediate institution one can rely on for assistance. This is not in consonance with the study by Vincent (2007) where friends, family and traditional leaderships were used as proxies for households' social capital in rural areas. The results of the analysis are presented in Table 6.5.

Table 6.5: Relationship between gender and social organisations respondents belong

Study site	Sex	Social Organisations					
		Church	Welfare Association	Political Party	Community Based Organisation	Farmer Cooperative Unions	Civil Society
KAPND	Male	47 (31.5%)	35 (23.5%)	44 (29.5%)	62 (41.6%)	37 (24.8%)	71 (47.7%)
	Female	50 (33.6%)	33 (22.1%)	39 (26.2%)	74 (49.7%)	33 (22.1%)	57 (38.3%)
	Sub-total	97 (32.6%)	68 (22.8%)	83 (27.9%)	136 (45.6%)	70 (23.5%)	128 (43.0%)
KpMu	Male	22 (14.0%)	45 (28.7%)	137 (87.3%)	132 (84.1%)	137 (87.3%)	85 (54.1%)
	Female	15 (9.9%)	36 (23.8%)	124 (82.1%)	121 (80.1%)	117 (77.5%)	70 (46.4%)
	Sub-total	37 (12.0%)	81 (26.3%)	261 (84.7%)	253 (82.1%)	254 (82.5%)	155 (50.3%)
Both (KAPND & KpMu)	Male	69 (22.5%)	80 (26.1%)	181 (59.2%)	194 (63.4%)	174 (56.9%)	156 (51.0%)
	Female	65 (21.7%)	69 (23.0%)	163 (54.3%)	195 (65.0%)	150 (50.0%)	127 (42.3%)
	Total	134 (22.1%)	149 (24.6%)	344 (56.8%)	389 (64.2%)	324 (53.5%)	283 (46.7%)

Source: Fieldwork (2016)

CBOs (64.2%) were the major social organisations respondents belong to, followed by political parties (56.8%) and farmer cooperative unions (53.5%). Surprisingly, majority of farmers identify themselves with the various political parties than farmer cooperative unions and welfare associations (24.6%). One would have expected majority of farmers to belong to either farmer cooperative unions or welfare associations, given the benefits and relevance attached to belonging to such unions or associations. However, the year under review (2016) was an election year for the national election, so various political parties were in the communities campaigning with promises and some motivations in the form of cash and farming inputs. As political beings, most farmers (both male and female) aligned themselves openly to some of the political groupings in order to receive support.

In addition, 46.7 percent of respondents indicated that they belong to civil societies while less than 23 percent of respondents identified themselves with churches (22.1%). In terms of the gender differences, more males belong to farmer cooperatives, civil society organisations and welfare associations than females (see Table 6.5), but more women were in Community Based Organisations (CBOs) - (65%). With the help of some CBOs such as Afram Plains Development Organisation (at KAPND) and Africare (KpMu) in collaboration with the Agricultural Extension Officers, women were mobilised and trained in good agronomic practices, and the groups were encouraged to form revolving Susu /savings groups to support each other financially in times of need. The group's solidarity was often used as guarantee for each other in repayments in case of default. The groups served as strong 'cushioning' support for over 70 percent of women farmers in the area. In addition, members in the groups developed stronger bonds in networking, sharing of information on the weather conditions, quality seeds and current prices of their produce compared to that of neighbouring communities (Egyir et al., 2017). The farmers' adopted strategies in coping with the changing climatic conditions as discussed resonates with

Giddens' view that structures (policies, rules, financial resources, infrastructure, and financial agencies that enforce these practices) can be created and re-created through human agency (male and female farmers, and actors in the institutions), with agents in the center (Holt-Jensen, 2009). That is to say, farmers / farmer groups could create, recreate and amend conditions / structure within their environment in favour of their livelihood activities at the face of the changing climate.

At the district level, majority of respondents in KpMu (82.5%) belong to farmer cooperatives relative to those in KAPND (23.5%). Comparatively, majority of respondents from KpMu identified with civil society organisations, political parties, and CBOs as compared to respondents in KAPND. A group member during an FGD reiterated:

Africare (a CBO) and my women's group saved my life when my whole harvest for the season and farm got burnt through bushfires last year. Coincidentally, I also lost three family members in the same year. The groups have since supported me to stand on my feet again. Now I have gotten some capital to cultivate at least half an acre land with exotic vegetable and I am following the appropriate planting methods taught by Africare and MOFA Extension Officers. Now, I can confidently say that, yields and sales are better and for that matter, I can smile now (A women farmer, KpMu).

It also came out from the interviews that, farmers were related to one another by blood, marriage, friendship or neighbourliness and cared much about each other. They shared salient information concerning rainfall changes, new technologies, and current market price of products freely. It was further realised that both male and female farmers support each other whenever a disaster strikes. For example small contributions in the form of money, or inputs like cassava sticks and corn seeds were collected to support victims in need.

In examining the support respondents receive from these social groups, the results in Table 6.6 show that a significant majority of respondents (86.6%) do not receive any form

of physical assistance from the various social organisations they belong to while 13.4 percent receive some form of assistance. It was found that, the churches (as social groups) hardly offered any financial assistance to member farmers. They however were supportive in offering counselling and moral supports. The Farmer Cooperative Unions which could have been a strong mouth piece in demanding the required support from government and other relevant institutions were rather found dormant. The results in Table 6.6 further indicate that, of the number that receives assistance from social organisations, there are more males (15.4%) than females (11.3%). This could be attributed to the fact that, often rural women are traditionally saddled with house chores in the evenings and have less time to join the evening house-to-house election campaigns that came with incentives from the affiliated parties. There was no statistically significant relationship reported between gender and assistance received in the event of climate change and variability effects ($p>0.05$). Even though majority of respondents in KAPND (78.9%) and KpMu (94.2%) do not receive any form of assistance from social organisations in the event of climate change and variability effects, a higher percentage of respondents from KAPND (21.1%) receive some form of assistance as compared to those in KpMu (5.8%). The results depict the low adaptive capacity of the farmers in terms of the social support they get from the social organisations they belong to in the event of any impact associated with climate change and variability in KAPND and KpMu. An opinion leader and farmer expressed much disappointment about the difficulty in getting any form of support for his farming activities as follows:

Nowadays, the growing and planting practices go with money and expensive inputs making modern farming difficult. However, we hardly get any external support as farmers. Most of us have joined the party political campaigns secretly or openly as a strategy to get something to support our farming activities. One party has promised a pumping machine for irrigation for the community if their party comes to power, so we are praying for such proposals to come true (An Opinion leader and a male farmer, KpMu).

Table 6.6: Relationship between gender and assistance received in relation to climate change and variability effects

Study site	Sex	Support Received from Social Organisations		
		Receives assistance from social organisation(s)	Do not receive assistance from social organisation(s)	Total
KAPND	Male	34 (22.8%)	115 (77.2%)	149 (100.0%)
	Female	29 (19.5%)	120 (80.5%)	149 (100.0%)
	Sub-total	63 (21.1%)	235 (78.9%)	298 (100.0%)
$\chi^2=0.53$, df (1), p value= 0.48>0.05				
KpMu	Male	13 (8.3%)	144 (91.7%)	157 (100.0%)
	Female	5 (3.3%)	146 (96.7%)	151 (100.0%)
	Sub-total	18 (5.8%)	290 (94.2%)	308 (100.0%)
$\chi^2=3.45$, df (1), p value= 0.63>0.05				
Both (KAPND & KpMu)	Male	47 (15.4%)	259 (84.6%)	306 (100.0%)
	Female	34 (11.3%)	266 (88.7%)	300 (100.0%)
	Total	81 (13.4%)	525 (86.6%)	606 (100.0%)
$\chi^2=2.12$, df (1), p value= 0.15>0.05				

Source: Fieldwork (2016)

6.5 SUMMARY

This chapter presented an analyses and discussions on the adaptive strategies adopted by farmers to cope with climate change and variability effects in KAPND and KpMu. Specifically, this was done to ascertain the various autonomous and anticipatory relative adaptive strategies often adopted to cope with incidence of crop damage and incidence of temperature increase and heat stress in KAPND and KpMu. The various determinants of the adaptive capacity of farmers to cope with climate change and variability effects were also discussed in this chapter. The section began with an analysis of the various crops that are mostly damaged as a result of changes in climatic conditions over the years. The result shows that cassava is the major crop (52.1%) affected by climate change and variability impact, followed by maize (34.3%) and cowpea (8.6%). The results further show that rice (0.3%), vegetables (3.0%) and groundnut (1.7%) are the least affected crops.

With reference to how farmers respond or react to incidence of crop damage and reduction in crop productivity in KAPND and KpMu, the results indicate that 34 percent engage in off-farm activities, 23 percent migrate in search of other job opportunities, followed by 15 percent who resort to change in agronomic practices and 13.5 percent rely on remittances for sustenance. Only 11 percent of respondents noted that they do not adopt any reactive or autonomous adaptive strategy. While a higher percentage of both males (36.6%) and females (35.0%) engage in off-farm activities, more females (18.3%) than males (11.8%) opt to change agronomic practices

In relation to the planned adaptive strategies often adopted by respondents in anticipation of the effects of climate change and variability of crops, the results indicate that 44 percent resort to use of weedicides, 24 percent use fertilizer and 14 percent turn to changes in planting time. In addition, 14 percent use new varieties of seeds during

planting season, 2 percent resort to planting of trees on the farms and mixed cropping. The variations within and between districts in relation to adaptive strategies were very clear: Whereas a higher percentage of respondents in KAPND (35.2%) use fertilizer as a planned adaptive response to climate change and variability impact, majority of respondents in KpMu (76.6%) opt for weedicides.

In view of water stress and drought associated with temperature increase, 29.7 percent of respondents indicated that they plant drought resistant varieties and a higher percentage of respondents (32.2%) stated that they engage in early planting of their crops. In addition, mixed cropping (31%), planting of trees (11.1%), and planting on raised ridges (18.1%) were reported as major strategy farmers adopt in adapting to climate change and variability effects. Comparatively, more farmers preferred planting of late maturing varieties (22.8%) to planting early maturing varieties. Also, 16 percent of respondents resort to conserving soil water or mulching and 15 percent adopt rain harvesting as an adaptive strategy in anticipation of the impact of temperature increase on farming activities. Also, 18.4 percent of respondents fall on the use of irrigation as a means to cope with the impact of temperature increase while 16.6 percent plant in wetlands.

The determinants of the adaptive capacity of farmers were examined in relation to access to credit, their role in decision making, and social capital and effectiveness of institutions. In terms of access to credit, the results show that majority (51.5%) do not have access to credit whereas 48.5 percent have access to credit for farming. Comparatively, majority of respondents in KAPND (55.7%) have access to credit than those in KpMu (44.3%). This further shows the low adaptive capacity of farmers in terms of access to credit in the event of climate change and variability impact. Moreover, there is no significant relationship between sex and access to credit ($p>0.05$) as majority of both males and females do not have access to credit for farming. With regards to role in decision making,

majority of respondents (55.4%) reported that men and women play equal roles in making decisions affecting their livelihood. CBOs (64.2%) were the major social organisations respondents belong to, followed by political parties (56.8%) and farmer cooperative unions (53.5%). Surprisingly, majority of farmers identify themselves with the various political parties than farmer cooperative unions and welfare associations (24.6%). Nevertheless, majority of respondents (86.6%) do not receive any form of assistance from the various social organisations they belong to. Even though majority of both males and females do not receive any form of assistance, more males (15.4%) relatively receive some support from the organisation they belong to. The results depict the low adaptive capacity of the farmers in terms of the social support they get from the social organisations they belong to in the event of any impact associated with climate change and variability

CHAPTER SEVEN

INSTITUTIONAL ARRANGEMENTS AND SERVICE PROVISION FOR SMALLHOLDER FARMERS

7.1 INTRODUCTION

This chapter discusses the available institutional arrangements for smallholder farmers, the various contributions these institutions make towards minimizing the negative effects of climate change on smallholder farmers and how these instituted support systems are experienced differently by men and women. This chapter is segmented into three sections; the first section identifies the types of institutions or organisations available in the respective districts selected to support smallholder farmers in addressing challenges associated with climate change. The second section identifies and discusses the kinds of support provided by the institutions identified, the various roles and services provided towards improving agriculture in the districts. The last section presents analysis of the challenges associated with equitable access to institutional support towards smallholder farmers' livelihood development and sustainability.

7.2 TYPES OF INSTITUTIONS AVAILABLE TO SUPPORT FARMERS IN ADDRESSING CHALLENGES ASSOCIATED WITH CLIMATE CHANGE AND VARIABILITY

Farmer support services are very critical for effective farmer adaptation to climate change (Ngigi, 2009). The study identified four main categories of institutions or organizations which supported smallholder farmers directly or indirectly towards addressing the impact of climate change within the study areas. These institutions included social institutions (churches, family, farming groups and associations, opinion leaders - chiefs and traditional leaders etc.), financial institutions (banks, credit unions/welfare, microfinance institutions etc.), government institutions (Ministry of Food and Agriculture (MOFA),

Forestry Commission etc.), and non-governmental organizations. Table 7.1 shows a general distribution of the major institutions supporting farmers in adapting to climate change impacts in the two study areas.

The types of key public institutions identified by farmers include the district assembly, MOFA, Forestry Commission, Meteorological Agency, Financial institutions, NADMO, Chiefs and Opinion Leaders. These were noted for playing active roles in supporting various farmer groups in adaptation. The various NGOs identified included Africare (in both districts), APDO in KAPND and CRAN in KpMu. In all, nine (9) institutions were identified for KAPND and eight (8) in KpMu. There was no formal farmer organisation with established offices and a strong influence on farmers' activities in both districts.

The specific financial institutions named during the FGDs included Ghana Commercial Bank (in both districts), Rural Banks (Afram Rural Bank in KAPND, and Asubonteng and Woeto Rural Banks in KpMu). Also GN Bank in KAPND and Agricultural Development Bank (ADB) in KpMu were also identified by respondents. All the banks were supporting individual farmers and community savings and loans operation. However, many farmers complained about the high interest rate which was 18% per six months and 32% per annum in the two districts. It was observed that bad experiences from rain failures leading to loan repayment defaults had caused banks to adopt stricter collateral measures on loans. For instance, in Afram Rural Bank in KAPND, farmers were to present two guarantors who work in the Civil or Public Service of Ghana with their payslips before loans were granted. Unfortunately, they were finding it difficult to get these guarantors. The banks' terms were same for both male and female farmers but from the in-depth interviews, it was revealed that more males than females had access to loans because they could afford the collateral in using other properties they have control over.

Table 7.1: Identified major institutions supporting smallholder farmers to adapt to climate change and variability

KAPND	KpMu
Financial	Financial
MOFA	MOFA
District Assembly	District Assembly
Forestry Commission	Forestry Commission
NADMO	NADMO
Africare	Africare
Afram Plains Development Organisation (APDO)	Christian Rural Aid Network (CRAN)
Chiefs and Opinion Leaders	Chiefs and Opinion Leaders

Source: Fieldwork, 2016

More importantly, in addressing this challenge, farmers in KAPND have developed and designed an innovative type of banking that supports farmers within the community groupings as an adaptive measure. The details of this ‘innovation-community banking’ are as follows: The communities have created ‘banking for the poor’, where community members contribute GH¢5.00 or more per week and can take up to GH¢600.00 after 6 months. The repayment is within three (3) months with GH5.00 per month interest. The group members share proceeds at the end of the year. A box has been made to store the monies, and there are three keys that can be used to open it concurrently. These keys are given to three trusted executive members who have to be all present before the box can be opened. Non-group members in the community can also take loans but with higher interest. The group meets once a week and this serves as a social security initiative for farmers.

The institutional support at KpMu was more intensive than in KAPND especially from NGOs like CRAN, NERICA and governmental programmes such as the Export Development and Agricultural Investment Fund (EDAIF), Competitive African Rice

Initiative (CARI), and Integrated Soil Fertility Management (ISFM). From the FGDs there were not much defined differences in accessing the services of these institutions for male and female farmers in support of their adaptive practices in both districts.

From the FGDs with farmers, they stated that MOFA is the leading institution that has assisted farmers in diverse ways to address the negative impact of climate change in both KpMu and KAPND. MOFA plays a key role in providing support for farmers because it is the main government institution mandated by law to help address food and agricultural issues in the country (MOFA, 2009). In both districts, it was observed that MOFA intensively assisted farmers with seed and fertilizer support five (5) years ago.

Indeed, in interviews with MOFA and the District Assembly officers in both districts, they confirmed that the sector has over the years developed programmes and policies to promote agricultural sustainability especially in the face of environmental challenges. Notable among the policies is the sectors' 'Food and Agriculture Sector Development Policy II' (FASDEP II) which acknowledges climate change as part of the environmental challenges confronting Ghana's agricultural development (MOFA, 2009). Between 2001 and 2008, the government of Ghana and multilateral organizations like the World Bank and African Development Bank (AfDB) collaborated with MOFA and initiated the 'Youth in Agriculture Project', and 'Block Farming Concept', among others.

They further explained that farm inputs were subsidized and supplied to farmers on credit to be repaid after harvest. Practical demonstration sessions and farms were organized for groups and individuals to be conversant with new and appropriate farming methods. In addition, educational programmes as well as technical advice were offered to farmers. It came out from the interviews that although there were no visible discrimination between male and female farmers in the delivery of services by MOFA, some female farmers were

of the view that because of their traditional roles which confines them mostly to the home, certain information do not reach them early enough for informed decision taking. Consequently, creating an enabling atmosphere for climate change interventions to benefit smallholders especially women at all levels is crucial for fair growth (Kiptot & Franzel, 2011). For that matter, key institutions that offer farmer support services need to assess the peculiar strengths and weaknesses of male and female farmers to be able to provide appropriate and timely assistance to improve their adaptive requirements (Egyir, 2014).

Farmers however indicated that the support they were receiving from MOFA had abruptly stopped with the change in government. Farmers saw the HIPC agricultural packages to be more favourable to their conditions. However, due to the change in government, the projects and programmes have stalled and farmers are calling back the re-introduction of those programmes in supporting their coping mechanisms. Farmers indicated that due to the current dwindling nature of support from government to the agricultural sector, their needs were not taken on board by the decentralised system where their concerns should be a key preoccupation of the District Assemblies. Farmers were of the view that the Assemblies' Medium Term Development Plans (MTDPs) should consider smallholders livelihoods as priority and therefore budget for them.

In KpMu, it was very surprising to many farmers that there is not a single tractor available for hiring during peak farming seasons. Therefore, a lot of farmers have to rent private tractors when the season is ripe at exorbitant fees. At times, before it gets to a farmer's turn, the rains have already subsided which negatively affects production as observed by a farmer. Similarly, farmers in KAPND mentioned during the FDGs that, they did not feel the presence of the Agriculture Extension Officers since the World Bank and AfDB projects ended two years back and wondered what was happening to their fate at the face

of the changing climatic conditions. One of the agricultural extension officers in KAPND confirmed the farmers' claims on the current performance of MOFA by commenting that:

Under the HIPC package, with donors like the World Bank and others supported MOFA and the agricultural extension units to build the capacities of farmers in new and appropriate modern farming technologies, input supply, improved seeds, infrastructural and credit supports. With a change in government, the policies and the accompanying incentives have also changed and the practical field demonstrations have reduced. Hence the sharp difference which is also affecting our delivery of services to farmers, yet we are doing our best. A lot of farmers are blaming MOFA for non-performance but we are doing our best to maintain standards (The District Director, Agricultural Extension Division of MOFA, KAPND).

Certainly, farmers' adaptation strategies are not wholly independent but are constrained or enabled by institutional processes (Comoe, 1977; Adger et al., 2005) and in this cases, the cessation of certain support services offered by MOFA has had negative impacts on farmers' adaption. As such, Ngigi's (2009) argument that there is the need for a drastic change in policy approach when there is threat for an equitable use and management of resources for poverty alleviation and socio-economic development for farmers is very relevant.

Notwithstanding this, the governmental agencies that worked under the decentralised system of the district assembly such as the Forestry Services and the Wildlife Divisions of the Forestry Commission organised series of capacity building programmes in prevention of bush fires, and laws about indiscriminate tree felling and others to farmers. In addition, they educate communities on effective forest management, combating climate change by planting trees, forest protection, and monitoring of bushfires. They also train farmers on how to create fire belts about ten metres wide around plantations and farmers' activities are monitored through patrols to prevent and control bush fires and indiscriminate tree felling. The Forestry Services Division targets men, women and the whole rural

community at large. The District Director of the Forestry Services Division of the Forestry Commission in KAPND reiterated during an in-depth interview that the Forestry Services Division has collaborated with the District Assembly in developing bye-laws on indiscriminate felling of trees, where farming communities are being sensitised about the law and the need to obtain a permit before felling a tree, creation of fire belts around their farms and communal tree plantations for communities.

It also came out from the interviews with the Unit Heads from the District Assemblies and confirmed by farmers that, the Department of Social Welfare and Community Development under the District Assembly supports the elderly and widows with GHC80.00 per month through the Livelihood Empowerment against Poverty (LEAP) programme. The Assembly also runs Ghana Roads Construction Project that engages local people in constructing feeder roads manually led by contractors. Examples are the Adeemmra and Bondaso after Bosom River to the reserves in KAPND. The project helps local people including male and female farmers to generate income while improving the road networks to help farmers easily cart their farm produce to nearby markets.

The National Disaster Management Organization (NADMO), under the Assembly also organised preventive disaster management sensitisation programmes for the farming communities. It has further, developed a disaster strategic plan to be incorporated into the MTDP of the Assembly in both districts.

Although the public sector or government is expected to provide infrastructure and services in enhancing household/community adaptation in the agro-ecological zones in Ghana (see Yaro et al., 2010), it became evident in this study that services like micro-credit and training are provided by CSOs and NGOs in the communities. For instance Africare, an agricultural support NGO, operates in both study districts to reduce farmers'

vulnerability to climate change and enhance their resilience and their presence is felt so much in their selected communities of operation. In KpMu, the Christian Rural Aid Network (CRAN) improves the quantum (tonnage) and quality of rice production in district and indeed, the entire region and sensitize farmers in nutrition education, health promoting, encouraging farmers to see farming as a business. Afram Plains Development Organisation (APDO), on the other hand, offers business advice, capacity building, and awareness creation in KAPND. Undeniably, farmers' livelihood strategies can enable or be hindered by policy and institutional context (Ellis, 2000) and thus, the support being offered by the MMDAs and CSOs/NGOs in the district is helping farmers take big slides in their livelihood ventures despite the unforeseen climatic risks.

The FGDs revealed that the commitment and intensification of NGO work and programmes was more felt by KpMu farmers than KAPND. Meanwhile, it was observed that, NGO services were provided equally for both male and female farmers in the communities. Yet, the APDO Officer in charge of Community Development who was interviewed made a critical observation that to her surprise, *'there is no gender desk officer in the District Assembly to spearhead women's concerns in the district's planned activities'*. She saw that omission as a big gap that could negatively affect equitable development in the community.

Also acknowledged by respondents as major contributors to climate change adaptation in the study area were the traditional authorities (chiefs and queen mothers), and some opinion leaders (assembly men, land owners and family heads). In KAPND for instance, chiefs, queen-mothers and landowners came together in collaboration with the District Assembly and organised educational programmes for the communities in addressing some of the negative practices that lead to serious climatic changes and consequences.

This observation is in line with government policies to involve traditional rulers /authorities in promoting agricultural development in the country. This is because about 80% of food produced in the country is from the smallholder farmers who are presided over by traditional authorities as landlords (MOFA, 2009). Studies have applauded this idea because when stakeholders at the local levels come together, they are best able to come up with locally-made interventions that promote adoption practices among smallholders (EPA, 2007; Yaro et al., 2010; Adjei-Nsiah & Kermah, 2012).

In the KpMu (see Table 7.1), the church as a social institution was observed to be one of the leading supporters of smallholder farmers in promoting agricultural development. It came out that some women joined the Women's Ministry and other welfare groups in the church that supported the vulnerable with either grants or loans with very flexible repayment terms. This encouraged such farmers especially women to show commitment in terms of their membership and participation in church programmes.

In the districts, political party groups, family supports and local Credit Union groups were fairly acknowledged for their contributions. These observations on the various institutional supports resonate with Egyir et al. (2014) who illustrate how institutions that support agricultural activities largely facilitate and shape farmers adaptation practices in various ways including expansion of farms, diversification, and storage strategies. A unique and indigenous institutional as well as adaptive support system that was observed and identified in the study was the 'barter' marketing system that contributed positively to climate change adaptation in both districts. The system supported farmers' livelihoods during critical climatic conditions where farmers did not have monies to purchase basic foodstuff and ingredients for survival. It highlights the importance of the structuration principle that articulates mutual dependence of structure and agency where the structural properties of social system are both the medium and the outcome of the practices that

constitute those systems (Giddens, 1991). In relation to smallholder crop production, the agent as well as people in the institutions and all actors need to work together and support each other in an interactive way by undertaking decisions and actions that would determine their livelihood outcomes, whether secure or not. One of the concepts cannot be independent of the other. Giddens therefore perceives human agency and social structure as inseparable concepts but as a two-way approach of considering social action.

It was observed that the local people still practice the old barter system of trading. Thus, those along the rivers/lake come with fish products in exchange for foodstuff and other items from the farmers. The market days are Wednesdays and Thursdays of every week at Donkorkrom, the district capital of KAPND. The early hours of the market days, that is between the hours of about 5.00am and 9.00am, are devoted to barter trading before the normal market commences. It involves fisher men/women and farmers along the lake bordering Kpando Torkor from the east, and the north, Bridge Ano or Ntoaboma towards Sene/Atebubu in the Brong Ahafo. This is similar to what was practiced in the colonial days between the Portuguese – being the first European country to arrive on the western coast of Ghana in 1471 (15th Century) and the host community members, where they exchanged western goods like schnapps, guns, mirror with local items like gold, pepper, timber and others.

It was further observed that farmers could even go a step further to buy some products on credit based on trust, if they did not have enough goods for exchange that particular market day. The farmers' practice is in conformity with Giddens' argument that agency is human and that human beings are not always passive receivers of authority from structures but the custody of agency permits them to act freely, making them less predictable as they can navigate the rules and norms to their advantage (Giddens, 1984). It also conforms to Giddens' duality of structure, where institutional properties of social

systems are created by human action and in turn shapes future actions (Giddens, 1991). The farmers have created this unique market system as an adaptation strategy for survival during climatic hazardous times and it has come to stay and has created a bright market system for future generations. In this case, the farmers have decided to keep to their own unique barter trade as an institutional and adaptation strategy in addressing the challenges posed by the changing climate.

The barter system allowed internal credit arrangements based on trust for those who did not have enough produce to exchange for an item in need. It was in favour of women in particular whose responsibility traditionally was to feed the households. The system serves as a survival as well as a poverty reduction strategy for the disadvantaged at the point of their needs as commented by a farmer:

This barter trade is a savoir to me and my immediate family. Because, every market day, I am able to exchange some food items with the basic items I need like fish, salt among others to be able to prepare food for my family of six daily till the next market day (A female farmer, KAPND).

Plate 7.1: Evidence of an on-going barter trade among women during a market day at Donkorkrom, KAPND.



There was co-ordination between institutions because whenever there was a problem like fire outbreak, the Police, Fire Service, and District Assembly quickly came together to jointly address the challenge. It was observed that institutions with statutory authorities were better able to plan and budget appropriately to run programmes than institutions without mandates (Egyir, 2014). It was observed however that, the local people and for that matter the farmers, had not developed the habit of maintenance and prevention so preventive disasters could easily overtake communities during crisis.

7.3 KINDS OF SUPPORT AND SERVICE PROVISION FOR FARMING ACTIVITIES

Regarding the kinds of support received by smallholder farmers to minimize the impact of climate change on farmers' activities, a wide range of support services were identified. These included financial support in the form of money and credits, capacity building, soil fertility management, agricultural inputs (fertilizers, pesticides, and improved seed), access to extension services and appropriate technology, marketing of farmers' produce, and infrastructural facilities, information sharing, and irrigation. These became apparent during in-depth interviews with institutions as well as questionnaire administration and FGDs with farmers.

Table 7.2 indicates the percentage distribution of respondents' opinions on the various categories of supports they received which enabled them to adapt to the impact of climate change in the surveyed areas.

Table 7.2: Types of support received by smallholder farmers in the two districts (multiple responses)

Type of Support	KAPND		KpMu	
		(N= 298)		(N= 308)
Extension Services	99	(35%)	152	(54.3%)
Soil fertility management	126	(44.5%)	66	(23.6%)
Capacity building	75	(26.5%)	49	(17.5%)
Irrigation/ infrastructure	137	(48.4%)	7	(2.5%)
Credit/financial	53	(18.7%)	13	(4.6%)
Input support /Improved seedlings	87	(30.7%)	11	(3.9%)
Marketing of produce	105	(37.1%)	12	(4.3%)
Information sharing	86	(30.4%)	30	(10.7%)
Appropriate technology	50	(17.7%)	24	(8.6%)

Source: Fieldwork, 2016

(i) Extension Services

In terms of the roles and functions provided by the institutions, farmers (over 54%) in KpMu indicated agricultural extension services as the most important function they received from the various institutions (see Table 7.2). This confirms the assertion that accessing the services of extension officers is crucial in supporting farmers' activities especially women (MOFA, 2013). Importantly, the study acknowledges that extension service delivery cuts across quite a number of the above mentioned categories of supports. At KpMu, it was observed that the MOFA team provided consultation on agronomic needs, training, and marketing among others to support farmers in the development of their adaptive skills to promote higher yields. For instance, CRAN in collaboration with MOFA extensively sensitized farmers on nutrition education, health promoting, agri-business, calculation of the current seasonal calendar to meet the right planting times, and good farming practices including fertilizer application. About fifteen (15) FBOs in collaboration with MOFA had benefitted from the programme.

(ii) Soil Fertility Management

Good soil fertility management support that farmers received recorded quite a high percentage of over 44.5% at KAPND and 23.6% in KpMu. The training in good soil fertility and effective agronomic practices was led by MOFA Extension Officers in collaboration with other NGOs like Africare in KpMu and Afram Plains Development Organization (APDO) in KAPND. They worked without discrimination among groups. They separated farmers depending on their peculiar situations by ensuring good farming practices such as composite farming with bumps and ridges as well as planting in lines are done. Definitely, these interlinking and collaboration of institutions at the local level in administering key developmental activities in supporting smallholder farmers in climate change adaptation is crucial for sustainable livelihoods as noted by Upholf (1986) and Egyir et al. (2014).

Additionally, from the in-depth interviews with NGO representatives in KpMu, Africare initiated a project entitled “Integrated Soil Fertility Management” (ISFM) and collaborated with MOFA’s Agricultural Extension Assistants (AEAs) in building the capacities of Farmer -Based Organisations (FBOs) in sustainable soil and agronomic practices. They supported farmers in the cultivation of staple crops in the region including cowpea, cassava and maize. The project looked at how best farmers could blend crops to add nutrients naturally to the soil. Cowpea for instance, is known to add nitrogen to soil so farmers were encouraged to inter-crop or rotate them with other crops for soil fertility and higher yields. They further trained farmers from different communities on how to collect soil samples, analyse and interpret their results. As a result of this exposure, many farmers indicated that they had become knowledgeable about soil improvement practices. One farmer had this to say:

With the training from Africare, now most of our women's group members are aware of the quality and quantity of nutrients various crops need. We are educated about the content of nutrients in both organic and inorganic fertilizers so we now do inter-cropping with crops that can enrich the soil like cowpea on rotational basis (A women's group leader, KpMu).

The project had also linked farmer groups to large agro input dealers/companies like Okata Farms and M&B Seeds at Ho. These companies were ready to buy farmers' produce while they in turn buy their seeds. These companies use accurate scales with fixed and better arranged prices than the traditional unfair measurement bowls (Olonka) used in the market. According to the Africare Project Manager, the next phase of the project will be the construction of a 'One-Stop-Shop Centre' containing a warehouse for storage, agro inputs shops, library and conference facilities for meetings and training workshops. Evidently, these big institutions have a strong influence, and through the support services they are offering, they are transforming the current coping capacity of farmers into longer-term adaptive capacity as acknowledged also by Leach et al. (2010). This makes the responsibility of institutions in assisting adaptation to climate change very significant (Egyir et al., 2014).

These findings also clearly indicate the importance of public private partnerships and how institutions can provide social services in response to the critical needs of farmers, which the government alone cannot bear (Robinson et al., 1997, Egyir et al., 2014). It was observed that, though there was no open gender discrimination in the target areas, male farmers were more informed about the current programmes and benefits than female farmers.

(iii) Capacity Building

The issue of capacity-building in terms of knowledge acquisition from organized training workshops from experts from MOFA, MMDAs, Forest Services Division of the Forestry

Commission and Africare from both districts, APDO (KAPND) and CRAN (KpMu) was received by most respondents. It came out that training in business management, entrepreneurial skills, storage, marketing and on-farm demonstrations were offered to farmers. For instance, the Wild Life Division Director, (KAPND) said his outfit in collaboration with Forest Service Division, MOH and Ministry of Education has built the capacities of farmers and supported farming communities in an apiculture (bee keeping) promotion project, where apiary (hives) are put in place for farmers as supplementary income generating ventures. It was observed that, having alternative income generating sources for farmers helped reduce forest degradation activities like firewood collecting for sale and charcoal burning.

FGDs also revealed that the two assemblies sensitised farming communities on environmental policies and laws including policies on afforestation, tree planting/ indiscriminate felling of trees without permits, REDD+ (forest maintenance and sustainability) and carbon sequestration. In addition, it was observed that the Forest Services Division of the Forestry Commission in KAPND educated communities on effective forest management, combating climate change by planting trees, forest protection, and checking / monitoring of bushfires. Majority of the farmers confirmed that they were taught to create fire belts about 10m wide around plantations to prevent bush fires. Further, these farmers' activities were monitored through patrols, to prevent bush fires, indiscriminate tree felling and also ensure reserves were not encroached upon.

In KAPND, information from the FDGs indicated that NADMO has established disaster prevention programmes in all the communities. The disaster-prone areas and communities have been mapped out and have been sensitized accordingly. They have encouraged and supervised the formation of fire volunteers in the communities and trained them as well for effective fire fighting. They have also put in place a hazard-preparedness plan that

includes anti-bush fire strategies to prevent the impact of fire outbreaks. The Assembly is also assisting three communities in growing cashew and mangoes to address land degradation and deforestation challenges, as well as serving as income generating activity for community members.

The assemblies' collaboration with NGOs and farmers in improving farmers' livelihoods resonates with Egyir et al.'s (2014) assertion that institutions facilitate and shape adaptation practices in various ways including diversification of livelihood activities, information, technology, funds mobilization, and training among others. Their projects often target the very poor, youth, farmers, women, men etc. and other vulnerable groups. It affirms the fact that government extension agents and NGOs are key drivers of change and support in the adoption of new agricultural practices, in promoting climate smart agriculture (Chaudhury et al., 2012). Certainly, this inter linkages of institutions is essential in fostering and understanding the adaptive capacities of communities (Berman et al., 2012).

Short term training programmes and seminars were also organised for representatives of community-based groups, fire volunteer squads and selected opinion leaders on bush fire campaigns and prevention in both areas.

(iv) Credit/ Financial Support

The identified financial institutions that offered credit support for farmers included Ghana Commercial Bank (in both districts), Rural Banks (Afram Rural Bank for KAPND, and Asubonteng and Woeto Rural Banks for KpMu); GN Bank for KAPND and Agricultural Development Bank (ADB) for KpMu. Yet, most farmers complained about their inability to access loans due to the strict collateral terms (demand two salaried workers as guarantors) as well as the high interest rate of about 32% per annum in KpMu and about

36% in the Afram Rural Bank in KAPND. Farmers indicated that their inability to tackle the changing climatic conditions was due to their low financial strength. Their productivity is then constrained by fundamental challenges like finances. A woman leader in her frustration during an interview reiterated:

With the current unstable rain pattern and climatic conditions, the only way out to make ends meet for farmers along the lake is to go into exotic vegetable cultivation. But then again it goes with irrigation and improved variety of crops which are expensive. It is also very difficult to access loans from any of the commercial banks hence our suffering in poverty and food scarcity (A woman farmer and leader, KpMu).

It was confirmed by the bank officials during the in-depth interview that they had become stricter on the collateral because of the high default rate due to rain failure for the past few years. It forced many farmers to fall on informal sources of support, particularly from susu operators, family members and friends. These banks as institutions may therefore be serving as barrier to most farmers since they are not able to support most farmers in promoting adoption of effective adaptation methods (Adjei-Nsiah & Kermah, 2012).

The FGDs revealed that in terms of repayment of loans and financial resource management, women were found to be more honest and sincere and so family/church members and other informal credit institutions trusted granting them support more than they did men. Again, women farmers in the target communities could easily form groups and do ‘revolving form of susu,’ using the group as guarantee for one another. This credit scheme adopted by women as noted by Egyir et al. (2014) serve as poverty reduction or livelihood enhancement strategy as well as climate change adaptation method. Since inadequate access to institutional support and norms could increase vulnerability of farmers with less power from using social and economic resources (Yaro, 2012), the informal financial support that farmers, especially female farmers are adopting provide an

alternative to deal with the inadequacies of formal financial support and in turn, reduce their vulnerabilities.

(v) Input Support

Input support was basically given by the NGOs in various districts. For instance CRAN, Africare and local seed companies in the district operated in KpMu, and APDO, Africare and Ricerca e Cooperazione (R&C) functioned effectively in KAPND. An Officer of Africare indicated that farmer groups in general were provided with improved seedlings, seed maize, fertilizers, and pesticides and they were made to pay back with cash or grain at the end of the season. In KpMu, it was observed that the seed growers had manufactured varieties of well packaged sachet and canned seed products for both irrigation and normal planting seasons. These products included sweet pepper, onions, cabbage, cucumber, pawpaw, okro seeds, tomatoes etc. The price for tomatoes – Petomech, 5 grams sachet was GHC10 with the canned type going for GHC60. MOFA in collaboration with APDO on the other hand, supplied wellington boots and cutlasses in KAPND.

The FGDs also revealed that Agricultural Extension Officers mobilised and sensitized farmer groups on the appropriate use of chemicals. However, many farmers who were not in groups missed out on this all important educative programmes and may probably use the chemicals anyhow. It was noticed that some farmers use the weedicides to kill trees wrongly. Luckily, MOFA has agricultural doctors who meet farmers every market day (any other five days round) where farmers bring samples for advice. These doctors who have been trained could also go to farmers' farms to observe the challenges themselves. This helped them to prescribe the right remedy.

Many farmers complained about lack of access to subsidized farming inputs since the HIPC's AfDP/World Bank project that targeted women and other vulnerable groups ended in 2012. They further reiterated that currently nothing is received from government through the District Assembly, which was very disappointing. According to IFDC (2012), timely access to adequate agricultural input utilization is important to ensuring economic development especially of farmers. In KpMu, farmers complained that the improved seeds/seedlings were expensive and delicate to handle and are tempted to keep to their old traditional seed cultivation.

(vi) Marketing

Donkorkrom in KAPND had a big market with two market days a week that is on Wednesdays and Thursdays. Similarly, KpMu has weekly market day at Kpando. Foodstuff from farmers, fish from fisher folks and traders from all over the country patronise since the zone is known as the 'food basket' for the country (Tachie Obeng, 2012; Owusu & Waylen, 2012) and prices of foodstuff is cheap.

Road network for the major roads were defined and tarred but some of the feeder roads were in very bad shape, with some impassable. Motor riders (okadas) do have field days during market days transporting individuals from surrounding communities. The only ferry that plied the lake and linked the northern and western parts of the country thus Brong Ahafo and Volta regions had broken down during the study and thus, slowing down business because a lot of buyers and traders could not come. Luckily, the government of Ghana in collaboration with the Dutch government had sent technical experts to work on it.

The nature of access roads unequivocally influences the demand and supply situation and even affects the types of crops to be grown by farmers. During the rainy seasons, many communities in the study area could hardly be accessed by big trucks except tractors (Ayivor et al., 2015). Majority of farmers have realized the linkage between good roads and marketing of their farm produce and are therefore calling on the District Assembly and for that matter the government to help in improving the road network for good market opportunities.

(vii) Information

Local Community Information Centres, NGOs/CSOs like Africare, CRAN, APDO, and the decentralised Departments of the District Assembly like the Department of Social Welfare and Community Development, Forest and Wild Life Divisions of the Forestry Commission organized series of advocacy programmes based on their mandates in both districts. The topics discussed included environmental bye-laws; modern and appropriate techniques of growing crops; effective farm management practices; nutrition and health related issues; agro chemical fertilizer and compost usage etcetera.

It is known that access to agricultural extension information for instance helps farmers make informed decisions (UNDP, 2010; Kiptot & Franzel, 2011). Nonetheless, male farmers were known to have more access to extension services and training, for it was not common for a husband to share information/knowledge gained from training with the wife. Again, women's domestic role of child and family care kept them too occupied to have time for personal development and in accessing extension related information as argued by Moser, (2003). This could affect women's space and capabilities in developing adaptation strategies to climate change which is in line with UNEP's view that the effects of climate change are likely to affect men and women differently as well as their coping

strategies. So essentially, efforts to address gender concerns in climate change should recognize and address gender inequities (MESTI, 2013).

(viii) Technology Transfer

MOFA and various agricultural related NGOs in both districts transferred skills in modern farm technologies and innovations to smallholder farmers in efforts to minimising the effects of climatic changes. The organisations supported farmers in at least one option of being chemical, mechanical, management or biological. The services included improved seed varieties (considering maturity and resistance to pests and drought) as biological; the usage of chemical fertilizers, pesticides, and herbicides for the chemical option; tractor and equipment and irrigation (soil and water management) for mechanical option; and the managerial option covered knowing the timing and type of planting, harvesting, and cultural practices such as use of cover crops, mixed cropping, multiple planting of same crop, and planting on ridges or in valley bottoms.

The organizations that supported them included the MMDAs, the decentralised Departments of the District Assembly like the Department of Social Welfare and Community Development, Forest and Wild Life Divisions of the Forestry Commission; NGOs/CSOs like Africare, CRAN, APDO in various districts, and MOFA. The above mentioned kinds of farm technologies or innovations were transferred as tools to smallholder farmers in addressing the effect of climatic changes on their activities (Egyir et al., 2014). It was however observed that, there was no adequate inter-sectoral approach to the coordination of sectoral environmental issues in relation to collaboration and clear demarcation of roles in climate change risk and vulnerability management at the local level (EPA, 2007; Egyir et al., 2014).

7.4 FACTORS CONTRIBUTING TO INEQUITABLE ACCESS TO INSTITUTIONAL SUPPORT

Diverse factors were identified by the respondents to have contributed to the inequities in access to the enumerated institutional supports (see Table 7.2). From the FGDs, prominent among these factors was the lack of knowledge of the services, lack of awareness creation, inadequate information about services, and access to services limited to specific people, inequitable access to extension services, traditional/cultural barriers, and women's excessive workload. The analysis is solely based on the in-depth interviews and the FGDs with selected respondents. The distribution of these challenges is illustrated in Table 7.3.

Although access to the support services provided by the institutions mentioned earlier was good in these districts (KpMu and KAPND), there were variations in how people actually accessed the services on a day-to-day basis (Figure 7.3). In relation to access to the support services provided, many respondents indicated that they had no knowledge of the existence of such services. This lack of awareness or ignorance by the local population is an institutional obstacle that needs to be addressed seriously to ensure higher agricultural productivity (Egyir et al, 2014). An important observation was that farmer support services are declining in the study communities so majority of farmers (90%) in both districts try to depend on their own resources, networks and local knowledge for survival as was also observed in other Sub-Saharan African contexts by Ngigi (2009).

Table 7.3: Factors contributing to inequitable access to institutional support in the two study districts

Factors Contributing to Inequitable Access to institutional support		KpMu		KAPND	
		Gender		Gender	
		Male	Female	Male	Female
Lack of knowledge of the services	Agree	115 (78.2)	123 (62.8%)	76 (53.1%)	79 (56.4%)
	Disagree	7 (4.8%)	2 (1.0%)	27.3%)	30 (21.4%)
Inadequate information about services	Agree	98 (63.6%)	112 (56.3%)	116 (84.1%)	102 (81.0%)
	Disagree	21 (13.6%)	13 (6.5%)	9 (6.5%)	12 (9.5%)
Services are limited to specific people	Disagree	48 (35.0%)	30 (31.9%)	0	0
Inequitable access to extension services	Agree	44 (36.7%)	59 (73.8%)	51 (43.2%)	47 (39.5%)
	Disagree	48 (40%)	35 (43.8%)	0	0
Traditional / cultural barriers	Disagree	61 (50.4%)	38 (45.8%)	0	0
Women's excessive workload	Agree	49 (39.2%)	59 (73.8%)	44 (37.6%)	39 (32.8%)
	Disagree	57 (45.6%)	41 (51.3%)	71 (60.7%)	79 (66.4%)

Source: Fieldwork, 2016

Concerning a question to further examine the adequacy of information available to those who knew about the existence of the services in their communities (see Tables 7.3), it is known that access to agricultural extension information for instance helps farmers make informed decisions. Nevertheless, it was found out from the in-depth interviews that extension services do not reach women farmers equally as their male counterparts and it is not common for a husband to share information or knowledge gained from training with the wife traditionally. It was also observed that in addition to the relative higher

literacy rate of males in basic education which enables them to read and seek for information on their own even from other sources compared to females, the higher workloads of women that confines them mostly to the home also prevent them from accessing relevant information. In explaining how the workloads of women affect their access to information, one a male farmer said:

I have not seen an extension officer openly discriminating against a woman farmer in their service delivery. The problem is the women themselves. Women farmers have traditionally 24 hour working workloads and have little time to seek for further knowledge, even with those who can read and write. You have just met us three this evening, sitting under this tree conversing and sharing current news and learning but our wives (farmers) are cooking and will not have that time (A male farmer, KpMu).

Often, cultural biases/barriers indirectly limit women from active participation in group training and extension meetings at the community levels (CARE International, 2013). These include high illiteracy levels, and lack of time due to excessive workload in performing their traditional roles. Though, it appears to be decreasing with enlightenment especially in the cities, yet in the traditional settings, women are not supposed to be too loud. Further, capital intensive technologies often do not necessarily benefit women (CARE International, 2013) because of limitations in educational levels among others. As such, women themselves may not even avail themselves for available institutional support services.

Further, the majority of male and female respondents agreed that the support services were accessed by selected people in the KpMu. This observation is remarkable since access to support services especially on agricultural production activities is supposed to be accessible to all. On the contrary, respondents in the KAPND indicated that there were biases in accessing the support services they received. It was revealed that people known

to the leadership who share information and support on behalf of the institutions are tempted to serving or reaching people known to them or acquaintances. This observation undermines agricultural development and farmer livelihood improvement in Ghana. The study in this regard concurs with the strong argument by the USAID that institutions that support the adoption of agronomic practices need to be assessed for their strengths and weaknesses to be able to provide assistance adequately for vulnerable social groups and to improve their adaptive capacities (Egyir et al., 2014).

It came out from FGDs that some female farmers are cautious in accepting new technologies of which they are not sure of its food security outcome (Opare & Wrigley-Asante, 2008). Having food in the right quantities and qualities was the heart desire of women farmers since they are responsible for feeding the families, no matter the scarcities. A woman leader stressed the need for women to think that way as:

Every woman's dream and prayer is to feed her family especially the children with at least a hot meal a day in right quantities. How can I accept a new technology which I am not sure of its contribution to feeding my family? It will be a risky game to play. (A female farmer, KAPND).

Nevertheless, it has been deduced from women's creativity and innovativeness in adapting to risky climatic conditions that women are active agents who have developed locally adapted, appropriate and sustainable coping strategies to climatic threats.

7.5 SUMMARY

The chapter examined the institutional arrangement and support available for smallholder farmers in minimising the impact of climate change within the study area. It further assessed whether the support services are experienced differently by men and women. The study identified four main categories of institutions which supported smallholder

farmers directly or indirectly in adapting to climate change impacts as social institutions (churches, family, farming groups etc.), financial institutions (banks, credit unions/welfare etc.), government institutions, and non-governmental organizations. KAPND developed an innovative type of banking that supports farmers within the community as an adaptive measure. About 85% of respondents stated that MOFA is the leading governmental institution that has assisted farmers in diverse ways with programmes to address the negative impact of climate change in both KpMu and KAPND.

The kinds of support received by smallholder farmers included financial supports in the form of money and credits; capacity building, soil fertility management, agricultural inputs supply, access to extension services and appropriate technology, marketing of farmers' produce, and infrastructural facilities, information sharing and irrigation. About 54.3% and 35% farmers in KPMU and KAPND respectively confirmed accessing of extension services as the most important function received. There were observed differences in the service delivery between the districts and gender concerns that should not be overlooked.

Prominent among factors that contribute to inequitable access to institutional support included lack of knowledge of the services, lack of awareness creation, inadequate information about services, access to services being limited to specific people, inequitable access to extension services, traditional/cultural barriers, and women's excessive workload. There were however, variations in how people actually accessed the services on a day-to-day basis within and between the districts as well as the sexes. An important observation was that farmer support services are declining in the study communities so most farmers (90%) in both districts try to depend on their own resources, networks and local knowledge for survival.

It was observed that cultural biases/ barriers, high illiteracy levels and lack of time due to excessive workload in performing their traditional roles indirectly limit women's active participation in group training and extension meetings among others at the community levels. However, women's creativity and innovativeness in adapting to risky climatic conditions was eminent as they have been active agents who have developed locally adapted, appropriate and sustainable coping strategies to climatic threats.

CHAPTER EIGHT

SUMMARY, CONCLUSION AND RECOMMENDATION

8.1 INTRODUCTION

This chapter presents a summary of the study's key findings. Following this, the study draws conclusions based on the findings, theoretical and conceptual frameworks. Lastly, it provides some recommendations based on the findings of the study.

8.2 SUMMARY OF MAJOR FINDINGS

The summary of major findings of the study are discussed below:

8.2.1 Level of knowledge and awareness of climate change and variability by gender of smallholder farmer

The results of the study indicate that majority of respondents were aware of climate change and variability. And comparatively, more males were aware than females in both districts. Also, majority of respondents in both KAPND and KpMu were aware of climate change and variability. Furthermore, the likelihood of climate change and variability awareness increases with being a male than female. Thus, males within the ages of 21-30 years and 31-40 years were 3 times more likely to be aware of climate change/variability than those above 60 years.

8.2.2 Differences in perceived causes of climate change and variability

Deforestation was reported as the major cause of climate change, followed by damages to water bodies and the ozone layer. Whereas majority of respondents from KAPND (84.8%) reported deforestation as the major cause of climate change, 63 percent of respondents from KpMu indicated damages to water bodies as the major cause of climate change, In terms of observed climatic changes, respondents stated changes in the duration

of the raining season, high temperature and low or inadequate rainfall. This suggests that farmers had observed changes in climatic variables such as rainfall and temperature.

8.2.3 High prevalence in the outbreak of diseases and reduction in crop productivity as physical effects of climate change and variability

In relation to the physical effects of climate change and variability in the study sites, reduction in crop yields and outbreak of diseases on farms were reported as the main physical effects of climate change in the region. Whereas majority of male respondents indicated reduction in crop productivity as the major physical effect of climate change and variability, majority of female respondents stated disease infestation as the major physical effect. Thus, gender significantly relates with reported physical effects in KAPND and KpMu.

8.2.4 Gender variations in the socio-economic effects of climate change and variability

Respondents identified the key socio-economic effects as waste of resources, increased hunger and weakness, food debts, increased family conflict and out-migration. Others include poor sanitation and lack of access to water, waste of productive time, loss of status, and inability to provide and improve the well-being of the family as some socio-economic effects of climate change and variability effects in KAPND and KpMu. Majority of males than females perceive loss of status in the family as a major socio-economic effect. This is because males are mostly the breadwinners of households and thus obligated to provide for the family.

Given the fact that women mostly bear the brunt in terms of increased burden of care, especially domestic or household chores, it was expected when the results reported a significant relationship between gender and loss of productive time, poor sanitation and

lack of access to water as socio-economic effects of climate change and variability. With reference to migration as a key behavioural response to climate change and a socio-economic effect, the results of the study showed that majority of males perceive out-migration as a major socio-economic effect.

8.2.5 Gender variations in the psychological effects of climate change and variability

Mental stress, loss of status, loss of confidence, inferiority complex, lack of concentration, and physical weakness were reported as the main psychological effects associated with climate change and variability effects in KAPND and KpMu. In addition, more males than females suggested mental stress as a psychological effect of climate change and variability. In situations where males sometimes feel humiliated and inferior, it could be aligned with male identity, masculinity and self-esteem and its implications at the household level.

8.2.6 Gendered reactive and planned adaptive strategies to incidence of crop damage and reduction in crop productivity

With reference to how farmers respond or react to incidence of crop damage and reduction in crop productivity in KAPND and KpMu, the results indicated that a higher percentage of the farmers adapt by engaging in off-farm activities such as charcoal burning, firewood harvesting, wild fruits and others resort to changes in agronomic practices such as the use of new drought resistant crop varieties of maize, okra, cassava, and the use of chemical fertilisers. In addition, 23 percent stated that they opt to migrate in search of other job opportunities. Moreover, 13.5 percent rely on remittances for sustenance. Also, there are no major gender differences in the kinds of reactive adaptive measures often adopted by farmers in both districts. Conversely, 11 percent of respondents noted that they do not adopt any reactive or autonomous adaptive strategy.

In relation to the planned adaptive strategies often adopted by respondents in anticipation of the effects of climate change and variability of crops, the results indicate that 44 percent resort to use of weedicides, 24 percent use fertilizer and 14 percent turn to changes in planting time. In addition, 14 percent use new varieties of seeds during planting season, 2 percent resort to planting of trees on the farms and mixed cropping. The typical situation of mixed cropping was intercropping of cassava and maize on the same field. At the district level, KAPND (35.2%) use fertilizer as a planned adaptive response to climate change, whilst majority of respondents in KpMu (76.6%) opt for weedicides. There were no gender variations in the kind of planned adaptive strategy adopted. It was found that farmers adaptation varied according to their location (farming on wetlands or mountains), financial strength (ability to afford fertilisers), sex (traditional sex roles), interests, experiences, responsibilities and other concerns (World Bank, 2009).

8.2.7 Lack of access to credit, role in decision making and social capital as determinants of low adaptive capacity to climate change and variability effects

With reference to farmers' access to credit facilities, the results indicated that majority do not have access to credit. Lack of collateral and inability of these financial institutions to take risk with these farmers' accounts for reasons why farmers cannot access credit.

CBOs were the major social organisations respondents belong to, followed by political parties and then Farmer Cooperative Unions. Majority of farmers identify themselves with the various political parties than farmer cooperative unions and welfare associations. The results of the study showed that majority of respondents (86.6%) do not receive any form of assistance from the various social organisations they belong. Yet, more males relatively receive some support from the organisation they belong to than females.

With reference to the role of farmers in decision making, majority of respondents reported that men and women play equal roles in making decisions affecting their livelihoods.

8.2.8 Types of institutions available to support farmers in climate change and variability adaptation

The types of key public institutions identified by farmers include the district assembly, MOFA, Forestry Commission, Meteorological Agency, Financial institutions, NADMO, Chiefs and Opinion Leaders. These were noted for playing active roles in supporting various farmer groups in adaptation. The various NGOs identified included Africare (in both districts), APDO in KAPND and CRAN in KpMu. The specific financial institutions named during the FGDs included Ghana Commercial Bank (in both districts), Rural Banks (Afram Rural Bank in KAPND, and Asubonteng and Woeto Rural Banks in KpMu). Also GN Bank in KAPND and Agricultural Development Bank (ADB) in KpMu were also identified by respondents. In all, nine (9) institutions were identified for KAPND and eight (8) in KpMu. There were no formal farmer organisations with established offices and a strong influence on farmers' activities in both districts.

8.2.9 Institutional support for farmers in climate change and variability adaptation

The kinds of support identified included financial support in the form of money and credits, capacity building, soil fertility management, agricultural inputs (fertilizers, pesticides, and improved seed), access to extension services and appropriate technology, marketing of farmers' produce, and infrastructural facilities, information sharing, and irrigation. The results further revealed that extension services was one of the prominent services provided by state institutions like the MOFA, extension officers and some NGOs such as CRAN.

8.2.10 Inequitable access to institutional support and services

Although the various institution provides support for farmers, there were reported variations in the service delivery between the districts and some gender concerns. Further probing into the causes of such differences revealed that lack of knowledge of the services, lack of awareness creation, inadequate information about services, access to services being limited to specific people, inequitable access to extension services, traditional/cultural barriers, and women's excessive workload were the major causes of unequal access to institutional support. There were however, variations in how people actually accessed the services on a day-to-day basis within and between the districts as well as the sexes. An important observation revealed that farmer support services are declining in the study communities so most farmers (90%) in both districts try to depend on their own resources, networks and local knowledge for survival.

It was observed that cultural biases/ barriers, high illiteracy levels, lack of confidence from socialization, and lack of time due to excessive workload in performing their traditional roles indirectly limit women's active participation in group training and extension meetings among others at the community levels. However, women's creativity and innovativeness in adapting to risky climatic conditions was eminent as they have been active agents who have developed locally adapted, appropriate and sustainable coping strategies to climatic threats.

8.3 CONCLUSIONS

Clearly, the findings of this study show, in varying forms, the differentiated impact of climate change and variability on agricultural livelihood of women and men farmers, especially in relation to their perceptions, effects on agricultural activities, adaptive

strategies, and institutional support. Even though the evidence presented thus far show that men are more likely to be aware of climate change and variability than women, both had observed changes in climatic variables such as rainfall and temperature. Also, it is evident that, even though the hazards associated with climate change and variability are experienced by both men and women who are farmers, the exposure and impact varies with gender, given the vulnerability of women vis-à-vis men (Ashley & Carney, 1999; Dankleman, 2010; Kakota et al., 2011). In addition, it is clear from the autonomous and anticipatory adaptation findings that, while there may be some subtle spatial and gender differences in modes of adaptive measures often adopted in the event of climate change and variability, individuals' ability to adapt are largely contingent on their knowledge and awareness, access to resources and information. While these determinants are of much relevance in terms of climate change adaptation, the effectiveness of institutions remains pivotal in enhancing the adaptive capacity of farmers (Kakota et al., 2011). Institutions serve as buffers and help mediate the ability of farmers to carry out their activities and strategies to achieve set outcomes. The study's findings are consistent with the theoretical perspectives defined in the Livelihood Vulnerability Framework (LVF) and the adaptive capacity framework (Scoones, 1998, DFID, 1999; Kakota et al., 2011, IPCC, 2011; 2014). The study suggests that other determinants such as social capital, access to credit facilities and role in decision making play very significant roles in adaption and also account for gender differences in adaptation. Thus, the study concludes that these factors interplay to influence access to and control over productive resources including information and decision-making processes of an individual small-scale farmer as well as influence the differentiated impact on the adaptive/coping strategies of farmers.

8.4 RECOMMENDATIONS

On the basis of the study's findings, the following recommendations are made:

- For equity and fairness in productive resource allocation to smallholder farmers, gender-sensitive climate change policies and interventions that focus on individual farmers, farmer groups, and communities' specific needs should be adopted by policy makers, government and non-governmental agricultural development agencies to minimize the effect of climatic changes on the livelihoods of farmers at all levels. Importantly, interventions should not target only women, but both men and women farmers who have concerns. This will help address the gender specific concerns of individual farmers, farmer groups and communities instead of the cast-in-stone or generalized solutions.
- In relation to negative anthropogenic practices by farmers, it is suggested that a broader educational campaign and sensitization of farmers and the masses on the climate change phenomenon be made by the central government (national level), the District Assemblies (local level) and other developmental agencies to create awareness as well as reduce bad farming practices and other activities that contributes to the changing climate. Climate change related psychological and health issues must be stressed since it is subtly destroying a lot of young farmers. Media platforms like the radio and local community centers that use the loud speakers at vantage points could be used to reach more farmers particularly women.
- The central government and development agencies at the national level should factor traditional adaption strategies into development plans and policies to enhance adequate adaptation and mitigation practices of male and female farmers in relation to climate change. Since climate change adaptation is localized, there is

also the need for local institutions to critically factor the needs of farmers into innovative adaptation policies and projects to enhance farmers' adaptive capacities.

- Government at the national level, the Metropolitan, Municipal and District Assemblies (MMDAs), and agricultural related agencies and NGOs should support farmers with equitable micro credit, agricultural inputs and infrastructural improvement systems to increase food crop production and yield. The introduction and sustenance of well-organized small-scale irrigation facilities along the lake and rivers for all-year-round vegetable cultivation to boost incomes, nutritional levels and general food security in the country is critical.
- The MMDAs should mainstream agriculture and climate change into their Medium Term Development Plans (MTDPs) and budget for them since the decentralization system mandates them to oversee the total development of the local people. They should make their presence felt by all community members especially the vulnerable groups.
- Finally, government should increase the scope and access to farmer support institutions to help smallholder farmers address the challenges of climate change and variability in Ghana.

8.5 AREAS OF FURTHER RESEARCH

The study assessed the gendered differential effects of climate change on the livelihood activities of smallholder food crop farmers in the transitional zone of Ghana. The study however identified certain gaps which may need further research as follows:

- Ascertaining indigenous adaptation strategies (e.g. barter) in addressing climatic hazards in the forest-savannah transitional zone of Ghana.

- Assessment of off-farm livelihood activities as a response to climate change and variability of smallholder food crop farmers.
- Exploring the emergence of political affiliation as a form of social capital for smallholder farmers' adaptation.
- Functional irrigation infrastructural system: An effective adaptation strategy for sustainable agriculture in the transitional zone of Ghana.

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APPENDICES

APPENDIX A

QUESTIONNAIRE FOR MALE AND FEMALE HOUSEHOLD HEADS; MALE & FEMALE SMALLHOLDER FARMERS; FOOD CROP SELLERS AND AGRO INPUT DEALERS

Questionnaire No.:

Date:.....

Location: (Region. /District):

Introduction

Over the years, the agricultural sector in Ghana has been faced with diverse challenges including climate change. These challenges are known to affect mostly women and children than men. This questionnaire is to help in acquiring data for a research to assess the effects climate change has on smallholder farmers in the Forest-Savanna Transitional Zone of Ghana. The information received from you will be kept confidential and so your co-operation would be sincerely appreciated. Thank you for your time and contribution.

Instructions: Please tick or fill in the spaces provided when appropriate.

SECTION A: BACKGROUND OF RESPONDENT

1. Community.....

2. Gender: a. Male [] b. Female []		Name of data collector:	
3. Age: (years)		Contact of collector:	
4. Marital status a. Single [] b. Married [] c. Divorced [] d. Widowed [] e. Others (specify)			
5. Number of children:		Males:	Females:
6. Level of education: a. No Education [] b. Non formal [] c. Basic [] d. Secondary [] e. Tertiary [] f. Others (specify)			
7. Is respondent the head of household? (If man is away > 6months/yr, then woman is head? Yes [] No []			
8. How many people stay with you? [.....] 8.1 How many of them go to school? Male [.....] Female [.....] 8.2 How many of your dependents are working? Male [.....] Female [.....] 8.3 How many of them are work outside home? [.....]			
9. Religion:		10. Occupation:	
11. Is farming your major occupation? Yes [.....] No [.....] 11.1 If Yes, how long have you been farming? [.....] years 11.2 If No, could you do others, specify the others			
12. What is your farm size (acres)? [.....] 12.1 Where is it located? a. Within the district [.....] b. Outside the district [.....]			
13. What crop(s) do you cultivate?			

SECTION B: GENDERED CLIMATE CHANGE AWARENESS AND PERCEPTION AMONGST FARMERS

<p>14. Have you heard that the climate is changing? a. Yes [] b. No []</p> <p>14.1 If yes, through which media did you hear of it? a. Radio [] b. TV [] c. Friends [] d. Neighbours []</p>
<p>15. What significant climatic changes have you experienced or noticed in the past 3 - 5 years? (Please explain).</p> <p>15.1 Has the changes stayed the same, increased, or declined over the past 3 – 5 years? (please explain)</p>
<p>16. In your opinion, what could be the reason for changes in climatic variables?</p>
<p>17. What would you consider to be the key environmental changes in your community due to the climatic changes? a. Erratic rainfall [] b. Persistent drought [] c. Floods [] d. Frequent bush fires e. Increased incidence of pest and disease f. Others (specify);</p>
<p>18. How has the experienced changes (in 17 above) affected your finances or household income? (as a male or female)</p>
<p>19. How has the above experienced changes (in 17 above) affected your production activities? – a. Crop damages [] b. Persistent low yield [] c. Increased crop insect/pest attacks [] d. Increased input cost [] e. Others (specify):</p>
<p>20. Do you think climate change affect men and women differently? a. Yes [] b. No [] Explain.</p>
<p>21. Who do you think is most affected by the above changes that you have observed in your agricultural production? Justify your answer. a. woman [] b. men [] c. both [] d. children [].....</p>
<p>22. Have you made any changes to your farming practices in the past 3 – 5 years? a. Yes [] b. No []</p> <p>22.1 If yes, specify: a. use of new crop varieties [] b. Following [] c. introducing livestock [] d. Intensifying use of ecosystems services such as hunting and collecting products from wild [] e. tree planting [] f. Usage of herbicides/ pesticides [] g. Introduction of new soil conservation measures [] h. Use of chemicals [] i. Others, specify</p>
<p>23. What measures could you take to avoid these losses? a. nothing [] b. change in agronomic practice [] c. migration to other area in search of food/job [] d. engaging in off-farm activities [] e. relying on remittance [] f. Others [specify.....]</p>

SECTION C: EFFECTS OF CLIMATE CHANGE

24. What are the physical effects of climate change on production activities? Please, state as many reasons as possible and explain.

.....

25. Does climate change effect on the selected given answer(s) (on above) impact differently on men and women? Yes [] No [] Please, give reasons for your choice

- a. Waste of resources:
- b. Increased hunger and weakness:
- c. Bad debts:
- d. Increased family conflicts:
- e. Out migration:
- f. Low status:
- g. Failure to improve family wellbeing:
- h. Waste of productive time & less productive activities:
- i. Decrease sanitation, hygiene
- j. Others []

26. Is the socio-economic effect of climate change on men and women farmers experienced differently?

Yes [] No [] Please, give reasons for your selected answer(s)

- a. Waste of resources:
- b. Increased hunger and weakness:
- c. Farmers being subjected to Food Debts;
- d. Increased family conflict:
- e. Out-migration:
- f. Decreased sanitation, hygiene and access to potable water for domestic use.
- g. Waste of productive time in less productive activities:
- a. Loss of status and failure of respondents to improve family well-being:

27. Did you have to raise money from external source for your farming activities?

Yes [] No []

If yes, how much capital did you raise? a. 100.00 – 500.00; b. 500.00- 1,000.00; c. 1,000.00 – 1,500.00 d. 1,500.00 2,000.00 e. over 2,000.00

28. Where did you get the source of capital from?
 a. Bank [] b. Micro Credit Institution [] c. Money Lender d. Friends []
 d. Women’s Group [] d. Family member [] Others, specify [.....]

29. How much profit do you make from your proceeds at the end of every planting season or annually?

30. How often do you save: a. daily [] b. weekly [] c. monthly [] d. seasonally [] e. yearly [] . Kindly justify your answer.

31. Are you able to access credit? a. Yes [] No []

32. If yes, where? a. Bank [] b. Money lender [] c. Relative [] d. Friend []
 Other (specify).....

33. If no (to question 39) why:

34. Does the changing climate have a direct or indirect effect on your health and that of your family?
 Kindly give reasons for your answer.
 a. Yes []
 b. No []

35. Are women and men equally involved in decision-making processes of programmes for farmers’ livelihoods?
 a. Yes [] Explain:
 b. No [] Explain:

36. Which social association (s) do you belong to? Tick as many as possible.
 a. Church [] b. Welfare association [] c. Political Party []
 d. Community-based Association e. Farming Cooperative [] f. Civil Society []

37. Does climate change have a direct or indirect psychological effect on you? a. Yes [] b. []

37.1 If answer is Yes (Q37), what are the psychological changes you experience as well as perceived in your life? Select as many that are applicable and explain answer(s).
 a. Mental stress []
 b. Loss of status []
 c. Lack of confidence []
 d. Inferiority Complex []
 e. Lack of concentration []
 f. Physical sickness / effects []
 g. Others (Specify)

38. Does the effect(s) on) above impact differently on men and women? Please, give reasons for your choice.
 a. Yes []
 b. No []

SECTION D: GENDERED CLIMATE CHANGE ADAPTATION

39. Which crop(s) did you cultivate since 2013 (3years back)?

.....

40. Which crops were most affected by climatic changes? Specify.

.....

.....

41. What measures did you take to avoid these losses?

a. nothing [] b. change in agronomic practice [] c. migration to other area
in search of food/job [] d. engaging in off-farm activities [] e. relying on
remittance [] Others [specify.....]

42. In what ways have you adjusted to the challenges you face as a result of climate change in
a short term ? Please, list them and give reasons.

.....

.....

43. What adjustments in your farming have you made to these long-term shifts in
temperature? Please, list them and give reasons.

a. Early Planting [] b. late planting [] c. Early maturing varieties d. late
maturing varieties e. Drought resistant varieties f. Rain water harvesting []
g. Mixed Cropping [] h. Soil water conservation / mulching i. Irrigation.[]
j. Planting on raised ridges
k. Planting on wetlands / valleys [] l. Others [specify:]]

44. In adjusting your farming ways, what are some of the challenges you face?

.....

.....

45. What other adjustments have you made in your way of living to reduce the constraints
from the changing climate? List them and explain each.....

.....

.....

Credit: provision of funds for increased access to purchased inputs.					
Education I: protection and restoration of water courses, and enforcement of community taboos and bye-laws.					
Education II: provision of up-to-date weather and climate information to farmers to aid them in planning farm activities.					
Education III: provision of early warning systems and training in emergency preparedness?					
Education IV: enforcing environmental protection through the regulation of the use of forest and wild life resources					
Education V: creating awareness on water, sanitation and related health issues					
Education VI: provision of extension delivery that responds to practical gender needs (e.g. training women and men farmers to improve their bargaining power, managing social tension and conflicts)?					

50. Do you know whether the support listed above is provided equally to men and women?

a. Yes [] b. No []

If no, what reasons do you think would account for these?

.....

51. Do you know of any official laws or guidelines (policies) that supports your farming activities?

Yes [] No []

If yes, explain.

.....

52. What prevented you from accessing any of the services provided? (Rank: 1=highest)

Rank

1. Lack of knowledge of the services []

2. Inadequate information about services []

3. Practices require a lot of labourers []

- 4. Services are limited to specific people (mention group) []
- 5. Practices demands many purchased inputs []
- 6. Practices introduced are time consuming []
- 7. Others (specify) []

53. Do these policies affect or benefit men and women differently? Yes [] No []

Please, justify your answer.

a. Yes: [].....

.....

b. No: []

.....

54. Is there any social development or social security initiatives for farmers? Are services provided same to men, women, children, etc?

.....

55. In your view, how can climate change be addressed in Ghana? Specify, whether the changes can be same to men and women.

.....

56. Do you have any additional suggestions for mitigating the impacts of climate change on our agricultural activities?

APPENDIX B

STRUCTURED QUESTIONNAIRE FOR MOFA, AGRICULTURAL EXTENSION, FORESTRY AND METEOROLOGICAL OFFICERS, MICRO FINANCE AGENCIES, NGOS/ CSOS, FOOD CROP SELLERS AND AGRO INPUT DEALERS WHOSE FUNCTIONS RELATE TO MANAGEMENT OF CHANGES IN CLIMATIC FACTORS AND RISKS TO SMALLHOLDER FARMERS.

Gender Dynamics of Climate Change Effects on the Livelihoods of Smallholder farmers in the Forest-Savanna Transitional Zone of Ghana

Introduction

Over the years, the agricultural sector in Ghana has been faced with diverse challenges including climate change. These challenges are known to affect mostly women and children than men. This questionnaire is to help in acquiring data for a research to assess the effects climate change has on smallholder farmers in the Forest-Savanna Transitional Zone of Ghana. The information received from you will be kept confidential and so your co-operation would be sincerely appreciated. Thank you for your time and contribution.

1. What is the name of your organization?
2. What is your position/role in the organization?
3. Does your organization involve in any type of activity that supports households to address the effects of climate change? a. Yes it involves directly [] b. Yes it involves but indirectly []
c. No it does not involve d. Others [specify]]
4. If the answer is yes (a and b) for Q69, what type of support?
a. provision of food aid [] b. provision of cash aid [] c. provision of business advice
d. provision of credit [] e. provision of education/involving in awareness creation campaign []
f. provision of improved technologies [] g. construction of infrastructures []
h. Other [specify.....]]
5. What are the methods used to offer the services to the vulnerable groups?
a. Demonstration [] b. Lectures [] c. Group work [] d. Handouts []
e. Marketing [] f. Construction of facility in community g.
Others.....

6. Who is the focus group for your organization?

- a. women b. men c. children d. farmers e. urban dwellers f. business group g. Others
[specify.....]

7. Do you have any project that addresses impacts of climate change (e.g. flood, drought) in the area?

- a. Yes b. No

8. If the answer to Q6 is Yes, what is the climate change related project(s)?

[.....]

9. How does the project address the needs of women and other vulnerable groups in the community?

.....
.....

10. Is your organization involved in disaster prevention activities?

- a. Yes b. No

11. If the answer to Q9 is Yes, what is the specific activity and how does it cater for women's concerns?

.....

12. In your opinion, does the government have a good / equitable strategy (targeting both men and women) for adaptation and mitigation of climate change? Explain your answer.

- a. Yes

.....

- b. No

.....

- c. I do not know

.....

....

13. What do you think is the major obstacle for addressing impacts of climate change for both men and women in successful and sustainable manner?

- a. inadequate budget b. poor timing of release of funds c. lack of awareness by local people d. high level of poverty in the area/region
e. lack of enabling policies f. lack of commitment from the local/regional government
g. Others [specify.....]

14. Who do you think should take the central role in addressing the vulnerability of the people to climate change?

- a. local people []
- b. government []
- c. private companies []
- d. NGOs []
- e. international organizations []
- f. developed countries []
- g. Others [specify.....]

15. Do the methods reach both men, women and other vulnerable groups equally? Explain your answer.

a. Yes []

.....

b. No []

.....

16. What kind of farm technologies or innovations have you transferred to small holder farmers in order to address the effect of changes in climatic factors?

- a. Tractor for land preparation []
- b. Early planting (Month) []
- c. Late planting (Month) []
- d. Early maturing varieties []
- e. Late maturing varieties []

- f. Drought resistant varieties []
- g. Pest resistant varieties []
- h. Weedicides (Brand name) []
- i. Pesticides (Brand name) []
- j. Rain water harvesting (amount captured) []
- k. Mixed cropping (additional crops) []
- l. Soil water conservation /Mulching []
- m. Irrigation (Type) []
- n. Planting on raised ridges []
- o. Planting in valleys/wetlands []
- p. Compost/manure (type) []
- q. Chemical fertilizer usage (type and brand name) []
- r. Others [specify.....]

17. Can you mention any short/ long term projects planned and implemented within the past 12 months? (Please list and indicate if they cater for needs of both men and women farmers)

a. Capacity building: -----

b. Technology and innovation transfer: -----

c. Credit: -----

d. Other (Specify) -----

18. Do women and men target beneficiaries allowed to participate in decision making for the development of service (projects/ program) packages? Explain your answer.

a. Yes []

.....

b. No []

19. Are existing low-cost and new technologies/innovations currently in design to reduce climate hazards for smallholder farmers in your area well-managed? Elaborate on answer.

a. Yes []

b. No []

20. To what extent would you agree to the fact that coordination / network between the various institutions (public, private & intermediary) for providing efficient planning and implementation of projects/ programs (services) to small holder farmers is strong?

a. Strongly Agree [] b. Agree [] c. Somewhat agree [] d. Disagree []
 e. Strongly disagree [] Don't know []

21. To what extend do you agree that the institutions in this area including yours have systems already in place to adequately contain climate hazard emergencies rather than wait to manage out-of-hand situations for both men and women farmers?

a. Strongly Agree [] b. Agree [] c. Somewhat agree [] d. Disagree []
 e. Strongly disagree [] f. Don't know []

22. What complaints have you received from households as you provide support that is intended to help address the effect of changes in climatic factors on them?

Complaint	Rank for males complaining (Rank 1= Highest)	Rank for females complaining (Rank 1= Highest)
Poor understanding of information provided		
Inadequate infrastructure		
Distant location of facilities		
Inadequate credit provided to meet new demands		
Only select group of people are benefiting		
Too much time spent during meetings		
Too much time needed to implement new practices		
New practices are too costly		
New practice hurt the environment		
New practices result in low product price		
Others (specify)		

23. Do you have any additional suggestions for mitigating the impacts of climate change on the agricultural activities of farmers?

APPENDIX C

**STRUCTURED INTERVIEWS FOR WOMEN AND MEN CHIEF FARMERS,
OPINION LEADERS, WOMEN AND YOUTH GROUP LEADERS**

Location (District):

Introduction

Over the years, the agricultural sector in Ghana has been faced with diverse challenges including climate change. These challenges are known to affect mostly women and children than man. This questionnaire is to help in acquiring data for a research to assess the effects climate change has on smallholder farmers in the Forest-Savanna Transitional Zone of Ghana. The information received from you will be kept confidential and so your co-operation is sincerely appreciated. Thank you for your time and contribution.

**GENDERED CLIMATE CHANGE AWARENESS AND PERCEPTION
AMONGST FARMERS**

1. Have you heard or seen that the climate is changing?

.....
.....

3. Have you experienced or noticed any significant change(s) in the climate / weather pattern for the past

4. 3 -5 years? (Please explain).

.....

3. What would you consider to be the key environmental changes in your community due to the changing climate?

.....

4. In your view, what could be the reasons for changes in the climatic variables?

.....
.....

5. Who do you think most is affected by changes in climatic factors? Give reasons.

a. Woman:

b. Men:

c. Both:

6. What measures could be taken to avoid these losses?
.....

7. Do you think climate change affect men and women differently? Explain your answer.
.....
.....

8. Has the changes stayed the same, increased, or declined over the last 5 years? (please explain)
.....

9. How has the above experienced changes (in Q2 above) affected farmers' finances or household income?
.....

10. How has the above experienced changes (in Q2 above) affected farmers socially as a male or female?
Explain, please.

- a. Loss of status []
- b. Increased family conflicts []
- c. Out-migration []
- d. Bad food debts []
- e. Others (specify)

11. How has the above experienced changes (in 12 above) affected farmers' food production activities?
.....

12. What are the perceived physical effects of climate change on farmers' production activities? Please, explain.

13. What are the perceived socio-economic effects of climate change on farmers' lives? Explain

GENDERED EFFECTS OF CLIMATE CHANGE

14. Does climate change effect impact differently on men and women? Please, give reasons

(social, economic, political etc.).

.....
.....
.....

15. How do smallholder farmers get access to funding for their farming or economic activities? Explain, whether the conditions are the same for men and women.

.....
.....

16. Are men and women equally involved in the decision making on what to do to address the effects of changes in climate factors at home and community levels?

- a. Yes [] Explain
- b. No [] Explain

17. What psychological changes or challenges do farmers' experience or perceive in their lives due to the climatic changes?

GENDERED CLIMATE CHANGE ADAPTATION

18. In what ways have smallholder farmers adjusted to the challenges faced as a result of climate change in a short/ long term as a male or female? Please, list them and give reasons.

.....
..
.....

19. What measures should be considered in the future to address the impact of the changing climatic conditions on farmers' activities? Please, give reasons.

.....
.....

GENDERED INSTITUTIONAL SERVICE PROVISION

20. Does anyone help farmers (youth, men, women etc) resolve problems caused by changes in climatic factors? If yes, specify.

.....
.....

21. Do farmers get services / supports from government, NGOs and other organizations to help them address these challenges? Please, specify the organisations and the support they offer.

.....
.....

22. How often can farmers access the services of any of the institutions in the last three years?

23. Has the assistance/ services offered been helpful to both men and women farmers? Elaborate on your answer.

24. Are these supports provided equally to men and women? Give reasons for your answer.

.....
.....

25. Do you know of any laws or regulations (policy) that support farmers' activities? Please, and then list them.

.....
.....

26. Do these policies affect or benefit men and women equally? Please, justify your answer.

.....
.....

27 What do you think is the major (s) obstacle for addressing impacts of climate change in successful and sustainable manner?

28. Can you mention any short/ long term projects (youth, women, elderly in agriculture etc) planned and implemented within the past 12 months benefitting both men and women farmers by any organisation or individual? (Please list)

.....

29. What complaints do you often hear from households about the provision of support that is intended to help in addressing the effect of changes in climatic factors on them? List them.

.....
.....

30. Do you have any additional suggestions for mitigating the impacts of climate change on smallholder farmers' agricultural activities?

.....
.....
.....

APPENDIX D

INTERVIEW GUIDE FOR FOCUS GROUP DISCUSSIONS FOR WOMEN, MEN, MIXED AND YOUTH FARMER GROUPS

This discussion will be carried out among men only, women only and a mixed group. Each individual will be given a chance to speak about what the situation is in the households and community mostly in general. We will use guided questions as well as others that will be necessary to clarify issues and responses provided. Participatory approaches including the PSP will be used to generate shared ideas in relation to their situations for effective inclusive community adaptive actions and projections.

SECTION A: Introduce Self and explain purpose of meeting

SECTION B: GENDERED CLIMATE CHANGE AWARENESS AND PERCEPTION AMONGST FARMERS

1. Have you heard that the climate is changing?
2. In what ways have you experienced or noticed significant changes in climatic conditions over the last 3 - 5 years ? (Please explain).
3. In your opinion, what could be the reason for changes in climatic variables?
4. How has the above experienced changes (in 2 above) affected your finances or household income? (as a male or female/)
5. In what ways do the above experienced changes (in 2 above) affect farmers socially? Explain, please.
6. How has the above experienced changes (in 2 above) affected farmers' food production and other activities?
7. What are the perceived socio-economic effects of climate change on smallholder farmers' lives?

SECTION C: GENDERED EFFECTS OF CLIMATE CHANGE

8. What are the physical effects of climate change on production activities? Please, explain.

9. What do farmers do to address the effect of changes in climate factors on their production activities? Are the adjustment practices adopted by farmers same for men and women? Give reasons to each practice.

10. Does climate change impact differently on men and women? (socially, economically etc). Please, give reasons for your choice

11. Can future effect of climate change be predicted by farmers, based on their previous experiences?

12. How was effect of climate change on your finances, health, and welfare for the past 3 - 5 years?

13. How do farmers get access to funding for their farming or economic activities? Explain, whether the conditions are the same for men and women.

14. Does the changing climate have a direct or indirect effect on the health of farmers and families? Kindly give reasons for your answer.

15. Are men and women equally involved in the decision making on what to do to address the effects of changes in climate factors at both home and community levels?

16. What psychological changes or challenges have you experienced as well as perceive in your life due to the climatic changes? Explain answer(s).

17. Does the psychological effect(s) impact differently on men and women? If yes, how? Please, give reasons for your answer.

SECTION D: GENDERED CLIMATE CHANGE ADAPTATION

18. In what ways have farmers' adjusted to the challenges you face as a result of climate change in a short / long term as a male or female? Please, list them and give reasons.

19. What adjustments in your farming have you made to long-term shifts in rainfall as a male or female? Please list them.

20. What agro chemicals do farmers often used for their crop production? Elaborate. How do you store your produce?

21. What prevents people from applying practices that are known to work well? (What are the barriers of adopting best practice adaptations to climate change?)

SECTION E: GENDERED INSTITUTIONAL SERVICE PROVISION

22. Do farmers get supports from government, NGOs and other organizations to help you address these challenges?

Please, list the organisations and their support / services they render.

.....

23. Are these supports provided equally to men and women? Give reasons for your answer?

.....

24. Do you know of any government laws / regulations (policies) that support farmers' farming activities?

Please, list them and explain

.....

.....

25. Do these policies affect or benefit men and women differently? Yes [] No [] Please, justify your answer.

.....

.....

26. What prevents people from applying practices that are known to work well? (What are the barriers of adopting

best known practice adaptations to climate change?)

27. Is there any social development or social security initiatives for farmers? Are these services provided same to men and women farmers and families?

.....

28. In your view, how can climate change be addressed in mitigating the impacts of the changes on farmers' agricultural activities in Ghana? Specify, whether recommendations should be same for men and women.

.....

APPENDIX E
THE NAMES OF FARMING SETTLEMENTS SAMPLED IN KAPND AND
KPANDO MUNICIPALITY

REGION	DISTRICT	COMMUNITY	FARMING SETTLEMENTS
EASTERN	KAPND	<u>Donkorkrom</u>	1. Donkorkrom Central 2. Kwaekese 3. Adiemmra 4. Agortime 5. Kayera (D’krom) 6. Alavannyo
		Mimchemfre	1. Anigye 2. Caterpillars Tornu 3. Kamalo 4. Bruben 5. Agodome
		Amankwakrom	1. Agodeke 2. Amankwaa Tornu 3. Apeabra 4. Asemaniye 5. Teacherkope
		Abotanso	1. Kofi Nyina 2. Abotanso I 3. Abotanso II 4. Abotanso III 5. Kwasi Kuma 6. Semanhyia 7. Apesika
VOLTA	Kpando Municipality	Gbefi	1. Hoeme, 2. Gbefi Tornu 3. Melevevio
		Sovie and Kudzra	1. Sovie Avenu 2. Abayeme, 3. Sovie Konda 4. Anyigbi, 5. Kudzra Dzigbe
		Kpando Central	1. Konda 2. Gabi 3. Aziavi 4. Adofe 5. Dzoanti 6. Gadza 7. Agbenoxoe 8. Dafor 9. Abanu
		Kpando Torkor	1. Avitikofe 2. Gborfe, 3. Tokor, 4. Togorme, 5. Dzigbe
Total			25